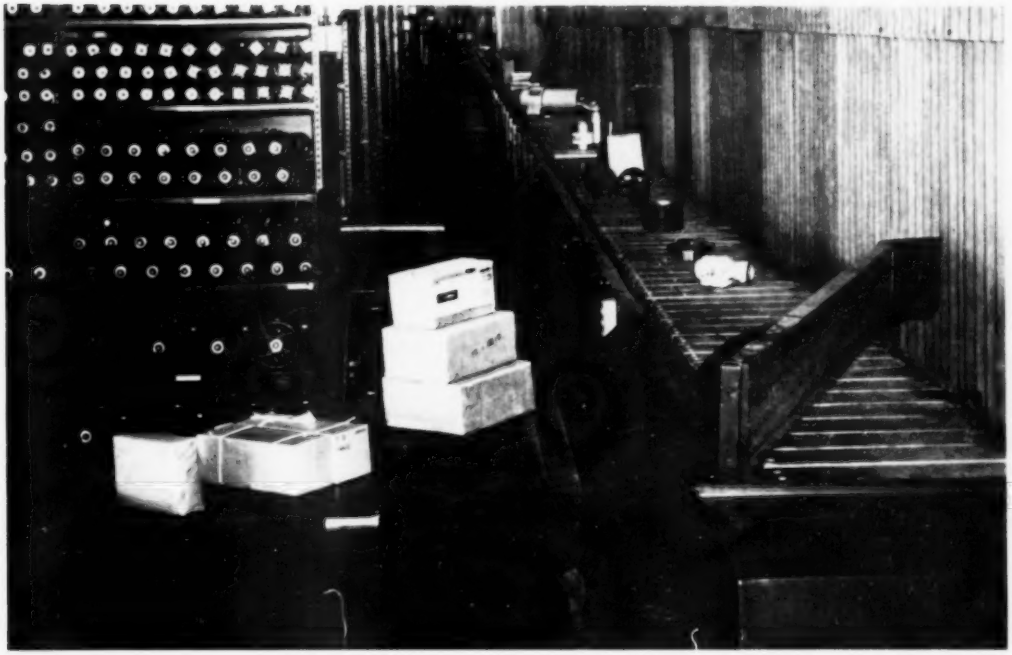
PETROLEUM PROCESSING

including Petrochemical Processing Section

AUGUST 1952



Do Your Stores Move Fast?

Handling devices, good planning put snap into warehousing—p. 1133

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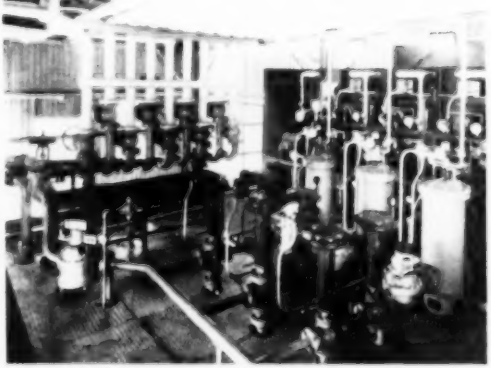
BLEND COMPONENTS *Continuously Automatically*



HEART of streamlined processing, this %Proportioneers, Inc.% Continuous, Automatic Blender combines base stocks and additives. It provides new speed, flexibility and economy in the production of uniform blends. The system reduces manpower, eliminates blending tanks, agitation, auxiliary pumps and attendant piping. Because the finished product is immediately available, tank trucks can be loaded without waiting. The %Proportioneers, Inc.% Continuous, Automatic Blender, preset to formula, controls component ratios and permits quick adjustment of output to suit demand rates. This installation at refinery of Richfield Oil Corporation at Watson, Calif., delivers a variety of finished products, exactly to formula, to trucks and/or storage tanks.

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Continued on next page

ETHYL
ANTIKNOCK COMPOUND
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Never leave well enough alone

Continued from preceding page

must be a better way to do almost anything. Our research engineers experimented with all sorts of ideas, but couldn't seem to find anything that would do the job any better.

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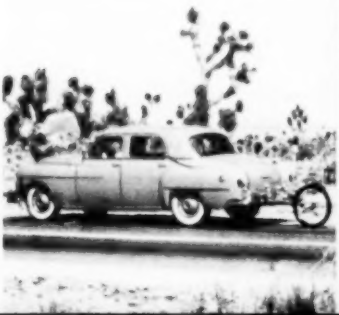
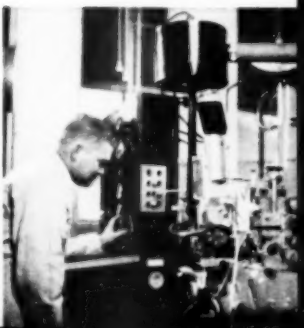
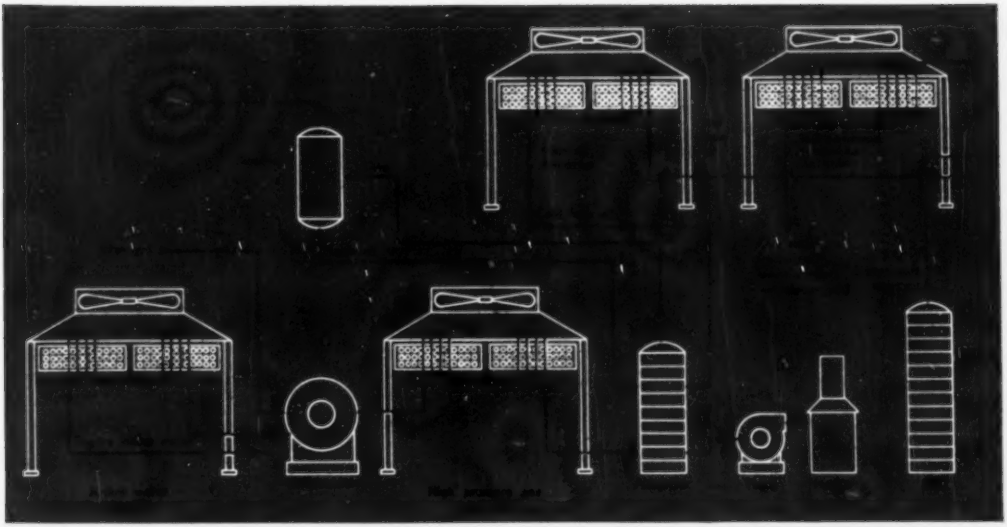




- **cooling engine jacket water**
- **cooling high pressure gas**
- **condensing overhead vapors**
- **cooling lean oil**



versatile ALCO AIRCOOLERS handle all these cooling duties at natural gasoline plants

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PETROLEUM PROCESSING

Covering petroleum research and the design, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals

August, 1952
Vol. 7, No. 8

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Publisher's Page

If You Don't Get Action, Tell Us!

"Reader Action" is a phrase that has been bandied about with considerable enthusiasm by the publishing fraternity in recent years. It encompasses all the overt reactions of readers to the editorial and advertising content of a publication.

The accurate measurement of "Reader Action" is becoming increasingly important in the purchase of advertising space. It is also one of the most realistic guides to the current interests of a publication's readers. Alert editors make good use of this information in planning feature articles.

One of our most consistent indications of "Reader Action" is your reply cards (page 1192), directed to our Reader Service Department, to obtain further information about new products listed in "What's New" and in advertisements.

Anyone who thumbs through a bundle of your reply cards from a heavy Monday morning's mail and sees the wide divergence of interests and occupations represented is bound to be enthusiastic about your responsiveness to PETROLEUM PROCESSING'S printed page. A few of you are presidents of large companies; many of you are plant superintendents, maintenance foremen, research chemists and project engineers—men engaged in refining, plant construction, petrochemical processing and equipment manufacturing.

More than one out of every four readers used our Reader Service Department at least once last year. Many of you repeated several times during the year. While our current analysis is still in progress, it is already evident that a far greater percentage of you are taking advantage of this service than ever before. You again set a new high during the first six months of this year by mailing us 21% more cards than during the comparable period in 1951.

We like to believe that one factor in the consistent increase since 1947 in your usage of this service is your confidence, through experience, that your requests to PETROLEUM PROCESSING will receive prompt handling. We've made quite a fetish of making certain that your requests are forwarded to manufacturers within 24 hours of the time we receive them. We also continuously spot-check with you to ensure that the manufacturer in turn has answered your request promptly.

Some manufacturers still exist who spend considerable energy and money to attract interest in their new developments, and then fall flat on their faces by failing to follow through with the requested information. Most manufacturers today, however, recognize the value of your interest as expressed through our Reader Service Department and are most anxious to co-operate in getting requested information to you promptly.

If the procedure ever slows down or breaks down, please let us know. We'll see that your "Reader Action" gets results.

A. W. Boulton

Other Platt Petroleum Publications

National Petroleum News
The weekly oil marketing magazine, covering news, prices, transportation, storage, merchandising

Platt's Oilgram News
A daily independent oil-news reporting service issued from New York, Cleveland and Houston

Platt's Oilgram Prices
A daily independent oil-price reporting service issued from New York, Cleveland and Houston

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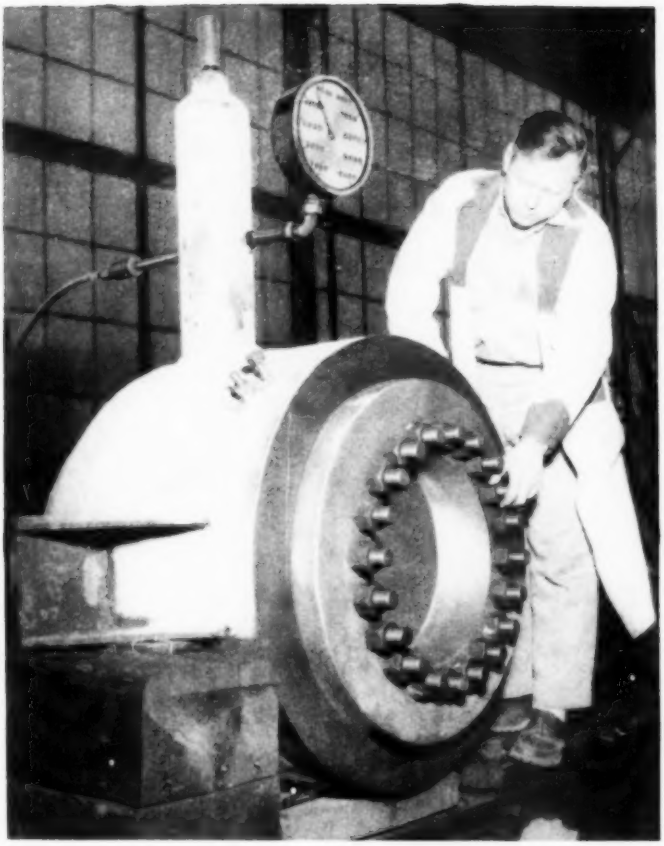
No design, metallurgy or manufacturing procedures are taken for granted in A. O. SMITH Heat Exchangers.



Testing the end closure and channel of a heat exchanger at 4800 psi. The closure is self-sealing, of modified Bridgeman type.

It is characteristic of A. O. Smith engineering to question every step in the process of building heat exchangers and pressure vessels. Inspection and testing of the assembled unit is not enough.

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And then, the engineering itself is tested during fabrication, as in the case illustrated. Components receive the most critical inspection and testing to be sure that the final assembled unit meets every specification exactly.

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What's Happening . . .

Expansion

. . . **Nearly three quarters of a billion dollars** will be spent this year by the petroleum industry for expansion of its processing facilities. According to a recent study by the American Petroleum Institute, domestic capital expenditures in 1952 will include $565,740,000 for refining, $82,170,000 for natural gasoline and cycling plants, and $66,350,000 for fertilizer and chemical plants—or a total of $714,260,000. Actual expenditures for these classes of facilities in 1951 were $370,410,000.

. . . **Expansion goal for natural gas liquids** has been pushed upwards by Defense Production Administration. Original program announced in April called for 43,000 b/d of new capacity in last half of this year and 88,000 b/d more next year. New goals are 60,000 b/d in last half of this year and 120,000 more in 1953. Petroleum Administration for Defense said it already has enough applications to cover expansion, which will increase total capacity of natural gas liquids to about 1,040,000 b/d by end of '53.

. . . **Proven Oil & Refining Co.** has received PAD approval for a proposed 15,000 b/d refinery at Florence, Ariz.—the first refinery in that state. Project will be supplied by planned West Texas to Los Angeles crude line, and will cost an estimated $18 million. Company president is L. M. Glasco, who also heads supplying line, West Coast Pipe Line Co. Engineering plans were drawn up by Efasco Services.

. . . **Humble Oil & Refining Co.** plans a new propane deasphalting unit to prepare catalytic cracking feed stock from heavy fuel oil at its Baytown, Tex. refinery. Humble anticipates 18 months to two years will be required for construction, although contracts have not yet been let for the $5 million project. Also planned by Humble are $4.2 million worth of facilities to recover propylene, butylenes and butenes.

. . . **Union Oil of California** has begun the next major phase of its refinery modernization program, construction of two 20,000 b/d crude topping units and a vacuum distillation unit, scheduled for completion in December, which will raise crude capacity from approximately 70,000 b/d now being processed to 110,000 b/d at Los Angeles refinery. Fluor holds contracts. Of the whole $27 million program, consisting of about 10 individual projects, something over $15 million has been finished, with completion slated for spring of 1953.

. . . **Imperial Oil Co.** has awarded contract to Fluor Corp. for major portion of $7 million modernization program at its Regina, Sask., refinery. Contract includes construction of 7,500 b/d Fluid catalytic cracking unit, 9,000 b/d vacuum distillation unit, and gas recovery plant. Refinery capacity will be increased 2,500 b/d—to 22,500 b/d. Construction is expected to begin late this year and to be completed by spring of '54.

. . . **Richfield Oil Corp.** will spend $40 million to expand its Watson (Los Angeles) refinery by 20,000 b/d (to 125,000 b/d). Project will include 13,000 b/d Fluid catalytic cracking unit, and facilities for ethylene recovery. Contracts have been let to Fluor Corp. and C. F. Braun and Co.

. . . **Globe Oil & Refining Co.** has signed contract with Armed Services Petroleum Purchasing Agency to build and operate a 1,500 b/d alkylation unit at Lemont, Ill. Military will probably buy straight alkylate from Globe, having it blended into avgas at some other point.

. . . **Standard of California** has purchased a "possible refinery site" in Snohomish County, Wash., 20 miles north of Seattle, covering 2000 acres and with a partial frontage on Puget Sound. Company reports it "hasn't any plans of any kind now for the use of this tract." (For a discussion of possible refinery expansion in Pacific Northwest area, see p. 1123 this issue.)

Petrochemicals

. . . **Carbide and Carbon Chemicals Co.** will build a new plant in Los Angeles County, Calif., to produce 50-60 million lbs. of polyethylene and 5-10 million gals. of ethylene glycol annually. Carbide has received a certificate of necessity for $36,323,000 for the new facility. Although exact location of the plant hasn't yet been announced, design and engineering work are now underway.

. . . **Lion Oil Co.** has let contracts for its new Barton Chemical plant at Luling, La. (What's Happening, May '52, p. 567). Chemical Corp. will be architect-designer and the Lummus Co. construction contractor. The new facility is expected to begin operation early in 1954 producing anydrous ammonia and prilled ammonium nitrate from natural gas.

. . . **Continental Oil Co.** has purchased the synthetic detergent plant of Stepan Chemical Co., Chicago. The Stepan plant reportedly is one of the largest producers of bulk synthetic detergents in the Midwest. It will be operated by Conoco's petrochemical department, and will be supplied with raw materials from Conoco's synthetic detergent ingredient plant at Baltimore, now being expanded to three times its present size.

. . . **Toluene production during 1951** rose to 101 million gals., with petroleum sources accounting for 55% of output, reports U. S. Tariff Commission. This figure represents a 17 million gal. production increase over 1950. Toluene sales in 1951 were 83 million gals., total value being $24 million.

. . . **Shell Chemical Corp.** is establishing a new marketing headquarters in Denver, Colo., for distribution of the company's agricultural products except fer-

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

tilizers. The new organization, known as the Julius Hyman & Co., Division of Shell Chemical Corp., will market the insecticides aldrin and dieldrin, Shell's soil fumigants "D-D" and "CBP-55," and its long line of spray oils which are marketed on the West Coast. The Hyman company was purchased by Shell earlier this year (see "What's Happening," June 1952, p. 727).

. . . **Gulf Research & Development Co.** has reorganized its Chemistry Division into a Product Division and a Process Division, with latter group including a Petrochemicals Section for further research in this rapidly expanding field. Also included in Process Division is a Refinery Processes section (concerned with refining methods and technology and operation of large scale pilot plants) and a New Processes Section (engaging in new refining processes development).

Foreign

. . . **Standard-Vacuum Oil Co.** has awarded construction contract for its new 25,000 b/d refinery at Bombay, India, to the Lummus Co. Head engineer of Lummus' coordinating department was in Bombay last month with an advance party of Stanvac's refining coordination representatives from New York to expedite field work.

. . . **Burmah Oil Co. and Shell** plan to build a new refinery at Bombay, India, with Burmah's share of cost estimated at some $25,200,000, according to Sir Kenneth Harper, chairman of Burmah.

. . . **Standard-Vacuum Refining Co., Pty., Ltd.**, new subsidiary of Standard-Vacuum Oil Co., has awarded engineering and construction contract for new 20,000 b/d refinery at Altona, near Melbourne, Australia, to C. F. Braun & Co. New installation will include catalytic cracking, crude topping unit, reforming facilities, light products treating equipment, and steam generating plant.

Industrial Mobilization

. . . **Applicants for accelerated amortization certificates** on industrial expansion projects costing $1 million or more must now fill out an additional form concerning plant dispersion. Although officials at PAD agreed it would be necessary for applicants for certificates on petroleum projects to file new form (Appendix B), general attitude in Washington was that requirement will have little significance. It was pointed out that oil companies usually don't build plants in highly-populated areas, or that when plant construction is undertaken in congested areas—such as Chicago or East Coast—exception to dispersal rule would be granted on grounds that other construction plans would not be feasible.

. . . **"Standard for Plant Protection"** is title of new security guide just published by Munitions Board for use primarily by businesses engaged in defense production program. New booklet supplements "Principles for Plant Protection" published by board almost two years ago. Copies are available from Supt. of Documents, Government Printing Office, Washington 25, D. C., at 20c a copy.

. . . **Facilities Securities Division** of PAD has been reorganized into Facilities Security Office headed by R. L. Allbritain, former Washington consultant. W. R. Boyd, III, who headed division from October '51 but has returned to Cities Service Petroleum, will continue as a consultant to PAD. Two others named consultants are J. H. Myers, Atlantic Refining and chairman of API's Plant Protection Committee, and F. W. Martinek, Indiana Standard and chairman of plant protection committee of Chicago Civil Defense Corps.

Markets, Prices

. . . **Further declines in residual fuel prices,** with inventories piling up rapidly due to dwindling industrial demand, overshadowed all other oil market developments in July. Settlement of the steel strike late in month was expected by the trade to save the market from "going to ruin," but it probably will be weeks before heavy fuel recovers from losses suffered during the 54 days steel mills were idle.

. . . **Other prices were firm** in virtually all refinery districts of the nation, with only minor exceptions. Gasoline was strong, and in some areas, notably the East, distillate fuels were moving in good volume to secondary storage in anticipation of record breaking consumption next winter. Atlantic coast prices for distillate fuels were up 0.65 to 0.8c a gal. under an Office of Price Stabilization order granting higher ceilings. At New York Harbor, tank car prices of 10.75c for kerosine and 9.75c for No. 2 fuel were posted by most refiners and tanker terminal operators.

To stimulate summer trade, one Oklahoma refiner cut his No. 2 fuel prices 0.625c, to 7.25c, Group 3, and there were widespread reports that other refiners in the Mid-Continent were "discounting" their posted prices. At the Gulf, solvent refined bright stock was quoted 2c lower at 32c a gal. for export. By and large, however, light products and specialty items were firm.

. . . **Heavy fuel storage tanks were virtually bulging** at the seams in all areas east of the Rocky Mountains. Gulf Coast cargo price for Bunker "C" was off 10c to $1.65 a bbl., and in Oklahoma No. 6 oil was offered at $0.90 a bbl., down 20c from end of June. Surplus of residual fuel was worldwide. Western European demand for Middle East crude was off inventories of heavy fuel were so large, refiners were short of storage for incoming crude shipments. Sale of approximately 1,200,000 bbls. of residual to Argentina for sterling aggravated the "dollar" market in the Caribbean.

Transition

. . . **Taylor Refining Co.** was renamed Taylor Oil & Gas Co. July 1. New firm's management personnel remain unchanged, and company will operate crude production and refinery at Corpus Christi, refinery at Port Isabel, and half-interest in McAllen gas field and cycling plant at McAllen, Tex.

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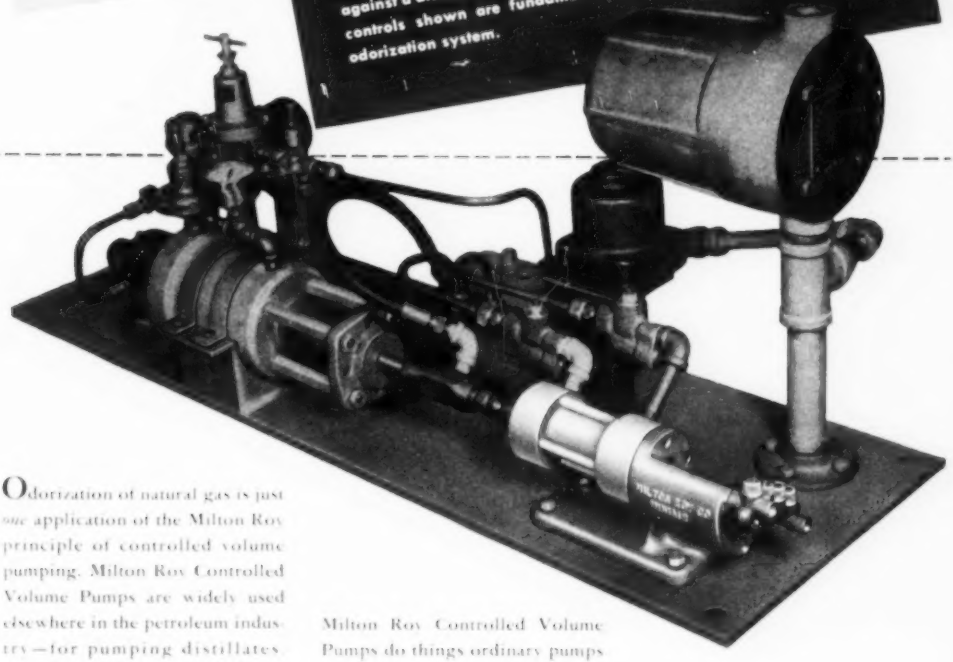

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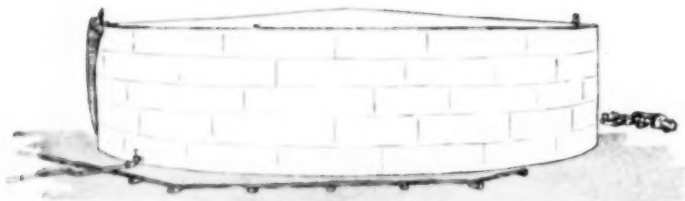

GRAVER TANKS

AT BAY REFINING CORP.
BAY CITY, MICHIGAN

Over a period of 15 years Graver has supplied tankage and a number of process vessels for the Bay Refining Corporation.

The battery of storage tanks which originally made up this installation was fabricated by Graver in 1937, immediately after the Bay Refining Corporation was founded. The following year these tanks were supplemented by five more, also built by Graver. Since that time Graver has continued to supply additional tankage to meet the requirements of Bay's expanding facilities. Included in the most recent equipment were two 120' x 40' cone roof tanks with a capacity of over 30,000 barrels each.

Only complete satisfaction with the original Graver products could have caused this refining company to return to Graver again and again as a source of supply. Such demonstrated confidence is the highest tribute that can be paid to the craftsmanship and ability of a manufacturer. This is only one example of the many industries which have placed this confidence in Graver.

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GRAVER

Radioactive Tracing vs. Other Wear Test Techniques

GROWING use of the radioactive tracer technique in a single-cylinder laboratory engine for determining engine wear, through the measurement of radioactive material worn off an irradiated part, is beginning to determine the relationship of this method to other techniques for measuring wear. These are the physical method (direct measurement of the worn parts) and the chemical method (analysis of iron appearing in the used lubricating oil).

"The measurement of wear by use of radioactive piston rings has attracted considerable interest in the past few years," it is brought out by C. C. Moore and W. L. Kent, of Union Oil Co. of California,[1] "largely because the method is extremely sensitive and changes in wear rates occurring in a few minutes or a few hours can be readily measured.

"The effect of a large number of operating variables can be measured in a short period of time, measurements that might have required years to make by direct physical methods. The effects of transitory phenomenon, such as changing from an oil of high wear rate to one of low wear rate, can be observed which would be impossible to detect by any other method. It is estimated that the radioactive method is several hundred times more sensitive than the iron analysis method . . . The engine is not dismantled to make radioactive wear measurements, so that mechanical factors should not influence wear values."

A disadvantage of the radioactive method may arise, these authors point out, if it were assumed that the wear rate of the irradiated piston part, as measured, is the same as for the cylinder wall. "Such a one-to-one relationship between ring wear and cylinder wall wear is not necessarily true."

The high sensitivity of the radioactive method can be a disadvantage from another point of view, it was brought out by the same authors. Because wear values may be obtained with such short runs, there is a tendency to overlook the influence of the factor of oil deterioration on wear rates. In longer tests, such as measuring wear by iron analysis or by direct measurement, the average wear rate with an oil over its period between oil changes is obtained.

The radioactive method requires elaborate preparations for a test, such as irradiating the piston ring and providing special equipment and safety precautions for handling the "hot" engine oils.

"Each of the wear methods has its field of application, the physical method for mechanical studies, the radioactive method of extreme sensitivity for studying operating conditions or fuels and lubricants problems, and the iron analysis method for ready application to the latter problems. Wear rate measurements by direct physical methods are, in a sense, the fundamental values on which the radioactive and iron analysis measurements are based. Both of the latter methods have been proven to be valid by checking against the physical method."

In their studies of the alleviation of engine wear attributable to corrosion in the cylinder zone, through the use of lubricating oils with a high degree of alkalinity, Shell Oil Co. investigators have used a new application of the radioactive tracer technique.[2]

In measuring the iron content of crankcase oil, a laboratory Diesel engine was operated for 20 hrs. on a fuel containing the radioactive sulfur isotope S35. Any radioactive sulfur found subsequently in the crankcase would then have originated in the fuel. The sulfur may be unchanged in organic form, or in an altered organic form as a result of reaction with fuel or oil hydrocarbons and oxygens, or combined with metallic oil additives and with iron corroded from the cylinders.

At the end of 20 hrs. the radioactive engine diet was suspended and the engine ran on for 180 hrs. on normal fuel. Plotting the decline of radioactivity of the crankcase oil during the 180-hr. period provided important data used in the analysis of iron in the crankcase oil and the further determination of the extent of corrosive wear in the cylinder zone.

—V.B.G.

(1) "Wear Measurements by Physical, Chemical or Radioactive Methods," C. C. Moore and W. L. Kent, Union Oil Co. of California, presented before Summer Meeting Society of Automotive Engineers, Atlantic City, June 1-6, 1952.

(2) "Wear Prevention by Alkaline Lubricating Oils," J. C. Ellis and J. A. Edgar, Shell Oil Co., before Summer Meeting Society of Automotive Engineers, Atlantic City, June 1-6, 1952.

45 Years in 15 Minutes—Is That Fast Enough Literature Searching?

THERE may have been "giants in those days," when such scientists as Lavoisier, Priestley and others flourished. But whether the men of stature yesterday were greater than their modern counterparts is a moot point. One thing we can be sure of—they didn't have to spend long tedious hours of literature searching, or hire a gang of competent experts to do it.

Today, any basic research must of necessity include the patient and careful checking on what's been done before. This has become expensive. It has been reported that in Sweden, one-third of the cost of research is for literature searching.

Tomorrow—the way International Business Machines figures it—the entire job can be done at high speeds by an electronic-mechanical system of handling information. A method promising to permit large segments of literature to be scanned in incredibly short periods of time was described at a recent symposium at Massachusetts Institute of Technology.[1] Prediction was that a machine could be designed ultimately to handle a search at the rate of 5,000,000 documents per hour. At that rate, the entire index for all *Chemical Abstracts*—from 1907 to date—could be scanned in about 15 minutes, and accurately too.

While these machines will bring new speed to literature searches, what is even more significant is that they will permit the adoption of a policy of total searching, according to the MIT Center for International Studies, where the development work is being carried on. A machine doesn't get tired or decide that it has gone far enough when it has reviewed "substantially" all of the material available.

The system is based on the standard IBM card but, contrary to customary practice of making electrical

contact by brushes through holes, it depends on rapid scanning by photoelectric tube. Also, in conventional operation position on the card determines significance of the holes, whereas in the new system it is the patterns of the holes, independent of their position. This avoids wasting space and permits information to be presented compactly. Cards can pass the scanner at 1000 /minute.

Only one experimental model of each of several types of this new machine have been built so far, and these are being used for exploratory work on coding systems. Machines are said to be about as complex as standard IBM machines now available commercially, and it is anticipated they will be available on similar terms. Production prototypes, however, have not yet been built.

It has not been established beyond reasonable doubt that punched cards will prove completely satisfactory for large fields; that is, over half a million documents. But present computers will not do the job either. In fact, they would be slower than the new card scanner. One of the fastest conventional digital computers now in existence, the MIT Whirlwind I, can perform over 16,000 comparisons per second. But, because it is limited to scanning for one item at a time, it would take more than 800 hours to search the index for a million documents.

Chief obstacle before the system can be made ready for general use is that a "machine language" will have to be developed. This is over and above the code that is used to express letters, numbers, and symbols in terms of holes and hole patterns. It refers to the way in which the elements will be put together so the machine will "understand" them.

W.C.U.

(1) "Mechanical Brains Translate New Era for Literature Searchers," News & Engineering News, July 7, 1952, pp. 2806-10.

Lubrication Has Important Role In Good Plant Management

THE higher speed machines and complex operations that serve industry today in many instances make proper lubrication of plant machinery and equipment an important factor in the profitability of the enterprise, D. F. Hollingsworth, of the du Pont engineering department, has pointed out.[1] Lubrication must be broadened by definition to include lubrication engineering, which this authority defines as "the art and science by which lubricants are most effectively used to minimize friction and prolong the life of machines."

Plant investment, production, quality of product, inventory, sales and safety are all influenced by the character of the lubrication engineering practiced. From the investment standpoint, "Perhaps management does not always appreciate the degree to which good machine design requires a knowledge of lubrication engineering if the machine is to satisfy the requirement of minimum investment and maximum output."

Careful planning and scheduling of lubrication increases output and lowers production costs, through avoiding machine breakdowns. After lubrication scheduling was adopted in du Pont's plant not only were savings made in cutting down the number of inspections and applications.

"Of even greater importance, the number of equipment failures was curtailed. In one of our machine shops, several thousand dollars was saved through proper scheduling. The year before scheduling was installed, more than 200 repair orders were issued due to lubrication failures. In the year following, there was not one failure due to lack of or improper lubrication."

In the chemical industry the wrong lubrication can affect quality of product. A chemical reaction can be effected by an insignificant amount of lubricant in the wrong place, and products can be stained or discolored or otherwise damaged.

In the procurement of lubricants the engineer and purchasing agent must cooperate to control inventories. "Lack of inventory control usually results in large supplies, with stocks on hand sufficient to lubricate some equipment for years and other parts only a few days." It is not unusual for increasing sales of a manufactured product to place an unexpected burden on production machinery and the importance of avoiding machine breakdowns due to faulty lubrication among other causes is greatly emphasized.

A considerable portion of plant investment today is in the machines and equipment which workers operate. The adoption of lubrication methods which will lessen machine breakdown and work stoppage thus becomes a more essential part of plant management.

—V.B.G.

(1) "The Importance of Lubrication to Industry Management," D. F. Hollingsworth, Engineering Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. American Petroleum Institute Lubrication Committee meeting, Tulsa, Okla., May 27, 1952.

Coal Mining Machine Turned Over For Commercial Development

FOR years it has been a recognized fact that a comparison of the methods for getting coal out of the ground to getting oil out of the ground soon relegated the former—with its back-breaking manual labor—to the horse-and-buggy days. Not that making hole isn't a "man's job," but at least the oil industry was spending time and money in developing the best possible techniques. And also, once oil flowed, modern machines could take over the job of producing the crude oil.

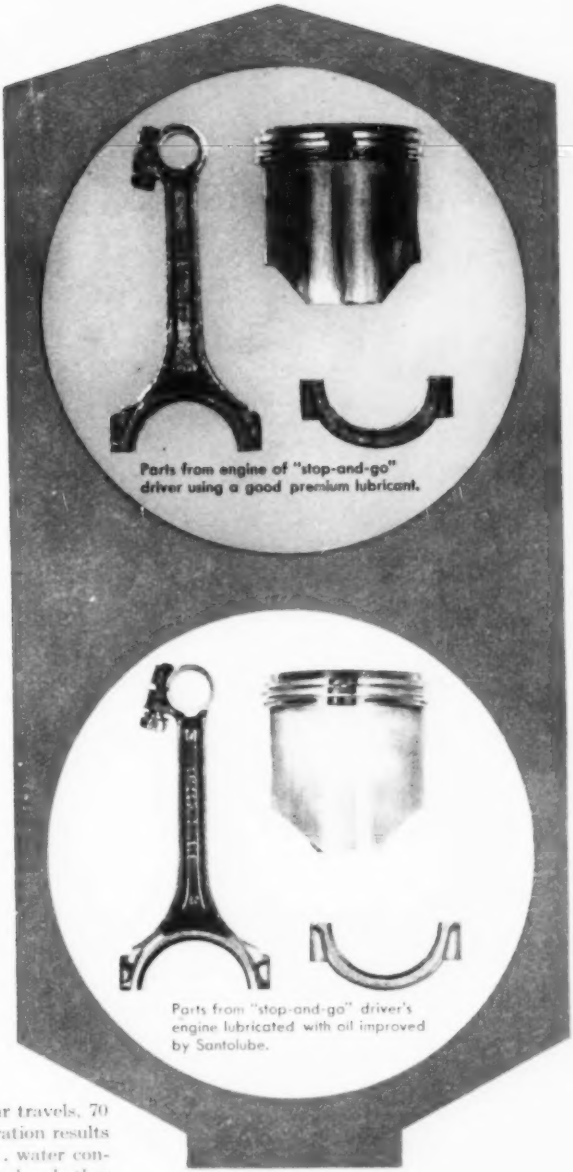
Things may change in the future coal industry however, particularly if the bituminous coal industry's research agency has its way. Bituminous Coal Research, Inc., has just announced the sale to the Le Roi Co. of the rights to manufacture and market the continuous mining machine developed under its Mining Development Program.

Le Roi plans extensive further development of the machine prior to commercial sale. The work will be carried on at the company plants in Cleveland and Greenwich, Ohio. Mining research, meanwhile, will be continued by the BCR in order to develop new and improved methods of bituminous coal mining.

A successful machine should certainly provide an answer to John L. Lewis' constant demand for safety in the mine. There is speculation in many circles, however, as to just how it might fit in with his constant demand for higher pay for miners. Perish the thought of a machine-operated union leader.

W.C.U.

Santolubes solve problem in "stop-and-go" driving



Parts from engine of "stop-and-go" driver using a good premium lubricant.

Parts from "stop-and-go" driver's engine lubricated with oil improved by Santolube.

Of every 100 miles that the average passenger car travels, 70 to 85 miles are "stop-and-go" driving. Such operation results in organic acids that cause high engine wear . . . water condensation that brings rust . . . partially oxidized fuel and other contaminants that build up deposits throughout the engine and cause excessive wear and oil consumption.

This problem of the "stop-and-go" driver can be solved by improving lubricants with Monsanto Santolube 388.

Compounding lubricants to fill the needs of "stop-and-go" driving is a joint project of the compounder and additive supplier. Why not let Monsanto help you? For complete details on the use of Monsanto Santolubes for "stop-and-go" driving, get in touch with MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

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Pardon My Ignorance
by Pinet

I thought A CATALYST SUPPORT was a crutch for a tottering tom . . . until I got the facts from Norton

Now I Know:

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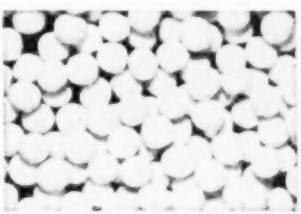
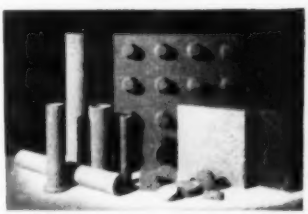


NORTON CATALYST SUPPORTS can be supplied in CRYSTOLON*, MAGNORITE*, FUSED STABILIZED ZIRCONIA and MULLITE, as well as in ALUNDUM, compositions. Each has its own special properties as a catalyst support. Each has the chemical stability and purity that eliminate contamination of both catalyst and end product.



NORTON POROUS MEDIUMS are made of ALUNDUM (fused alumina) in a wide range of sizes and shapes in plates, tubes, discs, and diaphragms for filtration, diffusion, aeration and electro-chemical applications. Patented controlled structure makes them uniformly porous. Highly resistant to acid and alkaline conditions.

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4P Geared Pipe Threader

No. 4P, 2½" to 4" pipe

Extra easy to carry and put on pipe

- ★ Balanced loop handles—easy to swing 4P where you want it.
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- ★ 4 sets of 5 high-speed steel dies for 2½", 3", 3½", 4" pipe. Ratchet handle; RIDGID Universal Drive Shaft available. Also special 4P for conduit.
- ★ Buy efficient 4P at your Supply House.

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(To obtain more data on advertised products see page 1192)

Letters

Chromatography

I have just read the article in your June, 1952 number by Herbert Weil, London, England, entitled "50 Years of Petroleum Chromatography; Part 1—Empirical and Scientific Eras." From the paragraph numbered "3" in the first column of p. 814, and from reference 31d, entitled "The Chromatographic Work of the National Bureau of Standards," readers will not understand that the work in question was done by the American Petroleum Institute Research Project 6 (largely by employees of the API when at the Nat. Bureau of Standards) which project has been at the Carnegie Institute of Technology since June, 1950, from which date all the work is being done here.

FREDERICK D. ROSSINI
Dept. of Chemistry
Carnegie Institute of Technology
Pittsburgh, Penna.

Motor Lubrication

One comment I would like to offer ["Lubrication of Electric Motors" May, p. 632] relates to the influence of ventilating air velocity on the oil level in oil lubricated bearings. This may be considered faulty design on the part of the motor manufacturer and a type of trouble that could not be considered as generally prevalent.

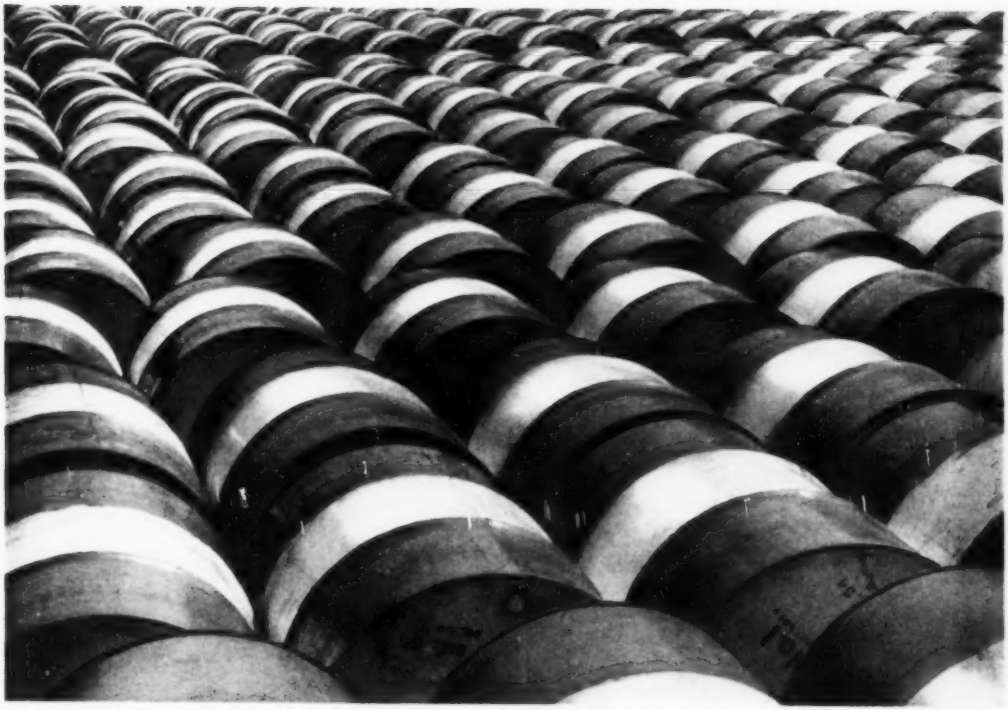
However, it occurs too often to be overlooked, and results when due consideration is not given to all factors of design. When the air velocity through a sleeve bearing motor is quite high, there is a tendency to pull the oil out of the bearing on the intake end of the motor. Some comment on this problem in the article might be of value.

JOHN C. HOWARD
Head Electrical Engineer
Standard Oil Co. (Indiana)
Whiting, Ind.

• I found this article very interesting and think Mr. Brewer has done an excellent job with one exception. I do not believe that he gave enough space in his article to oil lubricated, ball bearing motors. Perhaps his company does not use very many of this type, whereas Sinclair have in the past two years, installed and put into operation possibly 200, and have on order another 100 to 150 motors, all of which are of the oil lubricated, ball bearing type.

I feel that this type motor has a definite place in the petroleum industry and should be included in articles regarding electric motor bearings.

EARLE R. HOYLE
Electrical Engineer
Sinclair Refining Co.
East Chicago, Ind.



A cool 7800 barrels a day!

Cit-Con Oil Corporation's Lake Charles, La., plant is the largest in the world built exclusively for manufacturing of lube oil. Though rated capacity is 6000 barrels per day, it is actually running at 7800 bpd!

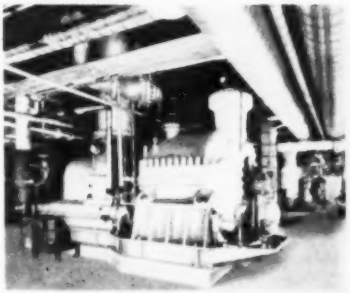
To produce this low pour point oil, Cit-Con uses two MEK dewaxing units equipped with 1165-ton Worthington Centrifugal Propane Compressors, with a standby compressor of the same capacity. The installation also includes 14 Worthington double pipe exchangers, 12 inclined direct expansion chillers, and 6 vacuum pumps.

Cit-Con is one of a large number of "big names" that have selected Worthington refrigeration. Others include: Esso Standard Oil Co., Bayonne, N. J., and Baton Rouge, La.; E. I. DuPont de Nemours & Co., Edgemore, Del., Orange, Tex.; Shell Chemical Corporation, Houston, Tex.; Socony-Vacuum Oil Co. Inc., Paulsboro, N. J., The Pure Oil Co., Smith's Bluff, Tex.; Standard Oil Co., Richmond Cal.; Sinclair Refining Co., Houston, Tex.; Tidewater Oil Co., Bayonne, N. J.

Important companies with world-wide reputations like these don't install *any* equipment on a haphazard basis. That they've chosen Worthington refrigeration is the best testimony we have for the conclusion: *there's more worth in Worthington.*

No other manufacturer makes so complete a line. And a Worthington system is Worthington-*made*—not just Worthington-assembled, assuring you of perfectly balanced operation and unit responsibility.

Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J.

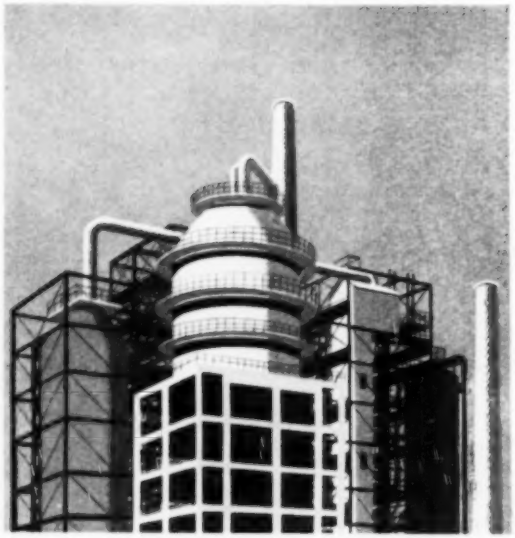


WORTHINGTON CENTRIFUGAL PROPANE COMPRESSORS at Cit-Con Oil Corporation's Lake Charles, La., plant. Engineer and Contractor: The Lummus Co., New York, N. Y.

A-1-44

WORTHINGTON

Air Conditioning and Refrigeration



Top Performance from Cat-Cracker Regenerators

A CAREFUL STUDY OF THE REGENERATION DATA FROM CATALYTIC CRACKING INDICATES THAT OXYGEN DISAPPEARANCE (USUALLY CALLED HYDROGEN IN COKE) INCREASES WITH INCREASING CARBON ON REGENERATED CATALYST. ABILITY TO CRACK GAS OIL, AS WELL AS GIVE GOOD GASOLINE TO CARBON RATIOS, DROPS RAPIDLY WITH INCREASING CARBON ON REGENERATED CATALYST; HENCE THE CATALYST THAT REGENERATES MOST EASILY CAN SHOW REAL ADVANTAGES. BY ITS NATURE, FILTROL'S CATALYST FLUID 58 HAS A FASTER REGENERATION RATE IN COMMERCIAL OPERATION THAN OTHER CATALYSTS IN GENERAL USE. THE BETTER REGENERATION RATE RESULTS IN BETTER OXYGEN UTILIZATION, HIGHER GASOLINE CARBON RATIOS AND GREATER RETURN FROM CAT CRACKING OPERATIONS.

ORSAT ANALYSIS	FILTROL* CATALYST FLUID 58	OTHER CATALYSTS
%CO_2	11.8	9.5 } 13:1
%CO	5.7	7.3 }
%O_2	1.7	2.5
CARBON BURNED, # HR.	18,500	17,900
HYDROGEN IN COKE	8.4	9.6
CARBON ON REGEN. CAT.	0.3	0.6

THE FIGURES SHOW THAT CO_2:CO RATIO IS NOT THE CRITERION OF REGENERATION CAPACITY.

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CATALYSTS AND ADSORBENTS

• . . . The article is very well planned and composed, indicating the author has done considerable research study into bearing lubrication theory and application. In this respect we believe that articles of this type are essential for proper understanding of bearing lubrication and associated problems, through which more co-ordinated effort on the part of bearing users will bring about solutions to these problems.

We feel, however, that there exists a definite need in the petroleum field for improved dissemination of information on actual experiences with different types of bearings and their lubrication. For example, the article infers that ring oil lubricated ball bearings possess definite advantages over other types . . . Yet nothing is said concerning actual experience, relative merits, and application limitations of this method.

We agree that there is a real need for information on motor lubrication, but please avoid the "text-book" type of article and give us up-to-the-minute information of methods, trends, experiences, and problems confronting the petroleum engineer.

LESTER M. GOLDSMITH
General Manager
Engrg. & Construction Dept.
Atlantic Refining Co.
Philadelphia, Penna.

Correction

Referring to the article on "Sulfur from Industrial Gases," which was published last March (pp. 333-338), the Shell Development Co. wishes that you print the following correction:

"The statement referring to the Shell Phosphate Process, that no carbon dioxide is removed from the gas, is too general. The owner of the process does not claim absolute non-removal of carbon dioxide. Selectivity is due primarily to a great difference in the absorption rates of hydrogen sulfide and carbon dioxide so that during the relatively short contact time in the extraction column, hydrogen sulfide is absorbed to a much greater degree than carbon dioxide. Hence, this selective extraction results from the non-equilibrium conditions existing at these processing conditions.

"As to the treating of hot gases, the Shell Development Co. writes that some installations have used this method. If, however, the hydrogen sulfide content of the gas has to be removed to the minimum, the low-temperature method must be applied. Cooling of the gases is also justified by the reduced steam requirements in this process."

PAUL ZURCHER
Tulsa, Okla.

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Once approved for production the vigil does not cease. Every step from pattern making to field installation is rigidly controlled and inspected. All machine processes in the Marley fan department are inspected by trained experts and any error means rejection. Final balancing that means smoothness of operation is done by men with years of training and experience.

This exacting method of development and production is assurance that the fan installed on any Marley cooling tower will do the exact job it is designed for. Actual tests of every kind over long periods have proved it.

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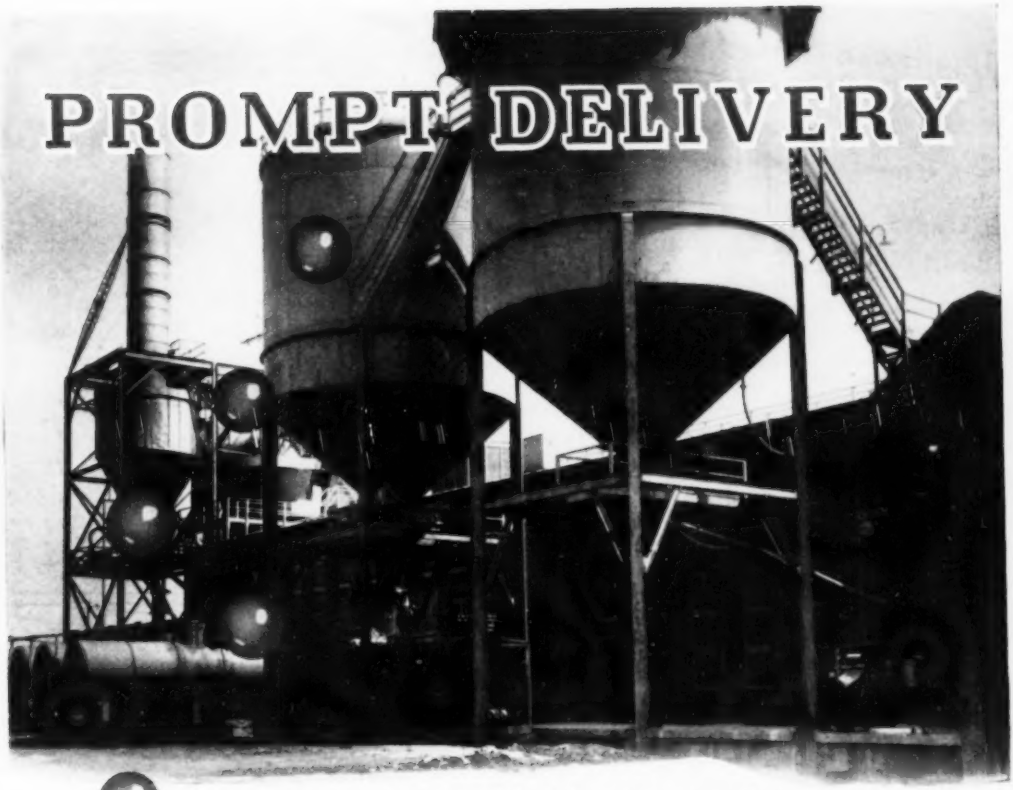
MARLEY

The Marley Company, Inc.

Kansas City 5, Missouri



This view of a corner of the Nalcat plant pictures the first step toward prompt delivery . . . . loading a freight car from one of the many Nalcat Storage bins.

from ADEQUATE STOCKS of Nalcat® CRACKING CATALYSTS

● An important advantage when you buy Nalcat "fluid" Cracking Catalyst is delivery—as promised. Further, prompt deliveries do not affect Nalcat purity, uniformity, or high activity characteristics . . . You get top quality whether your delivery needs are for tomorrow or in ninety days. Next time, order Nalcat for all-around catalyst performance.

Nalcat

FLUID CRACKING CATALYSTS

CATALYST DIVISION, NATIONAL ALUMINATE CORPORATION
4003 West 71st Street • Chicago 29, Illinois

(To obtain more data on advertised products see page 1192)

Hooker Chemical Guide
(ONE OF A SERIES)

USE this handy reference to save time in selecting high quality chemicals

HOOKER TOLUENE DERIVATIVES

BENZYL CHLORIDE

Synonym: Alphachlorotoluene
Formula: $C_6H_5CH_2Cl$
Appearance: Clear, colorless to light yellow liquid.

TYPICAL PROPERTIES

Molecular Weight	126.5
Freezing Point	−43° C
Distillation Range (Refined)	5° or less incl. 179.4° C
Distillation Range (Tech.)	6° to 10° incl. 179.4° C
Specific Gravity (Refined), 15.5°/15.5° C	1.107
Specific Gravity (Tech.), 15.5°/15.5° C	1.106

USES

Intermediate: Chemicals, dyestuffs, rubber accelerators, gasoline gum inhibitors, perfume bases, plasticizers, resins, wetting agents, pharmaceuticals.

BENZOIC ACID

Synonym: Phenylformic Acid
Formula: C_6H_5COOH
Appearance: White, odorless, crystalline solid. USP grade in powdered form; Technical grade in powdered or bead form.

TYPICAL PROPERTIES, USP GRADE

Molecular Weight	122.1
Melting Point	122.0° C
Benzoic Acid	99.3% Min.
Water	0.2% Max.

USES

Intermediate: Dyes, pharmaceuticals, perfumes.
Textile: Dyeing assistant, dye stripping agent, preservative for sizing.
Preservative: Foods, cosmetic creams, lotions, tobacco.

SODIUM BENZOATE

Synonym: Benzoate of Soda
Formula: C_6H_5COONa
Appearance: White, odorless, crystalline solid in flake or powdered form. Available in USP or Technical grades.

TYPICAL PROPERTIES, USP GRADE

Molecular Weight	144.1
Sodium Benzoate	99 + %
Benzoic Acid	0.2% Max.
Water	0.5% Max.

USES

Preservative: For foods such as tomatoes, fruit juices, syrups, margarine; also preservative for pharmaceutical and cosmetic preparations, tooth paste.
Corrosion Inhibitor: For glycol anti-freeze solutions, chlorinated solvent type metal cleaners, etc.
Chemical Intermediate: Dyestuffs and pharmaceuticals.

BENZOYL CHLORIDE

Formula: C_6H_5COCl
Appearance: Clear, colorless liquid.

TYPICAL PROPERTIES

Molecular Weight	140.5
Freezing Point	−0.9° C
Boiling Point	198° C
Specific Gravity, 15.5°/15.5° C	1.219

USES

Chemical Intermediate: Introduce benzoyl group into organic compounds.
End Products: Benzoyl peroxide, benzophenone and benzyl benzoate.
Derivatives: Include polymerization catalysts, bleaching agents, perfumes, dyes and pharmaceuticals.

BENZOTRICHLORIDE

Synonyms: Alphatrichlorotoluene
Phenyl Chloroform
Formula: $C_6H_5CCl_3$
Appearance: Clear, colorless liquid.

TYPICAL PROPERTIES

Molecular Weight	195.5
Freezing Point	5° C
Distillation Range	219° to 223° C
Specific Gravity, 15.5°/15.5° C	1.380

USES

Intermediate: Chemicals and dyestuffs.

MONOCHLOROTOLUENE

Synonym: Methylchlorobenzene
Formula: $CH_3C_6H_4Cl$
Appearance: Clear, colorless to straw colored liquid.

TYPICAL PROPERTIES

Molecular Weight	126.5
Freezing Point	below −45° C
Distillation Range	158.3° to 161.7° C
Specific Gravity, 15.5°/15.5° C	1.080

USES

Solvent: Rubber and synthetic resins.
Intermediate: Manufacture of rubber accelerators, chemicals.

For more information on items listed, drop a note on your letterhead to HOOKER ELECTROCHEMICAL COMPANY, 4714 Buffalo Avenue, Niagara Falls, N. Y.

HOOKER ELECTROCHEMICAL COMPANY

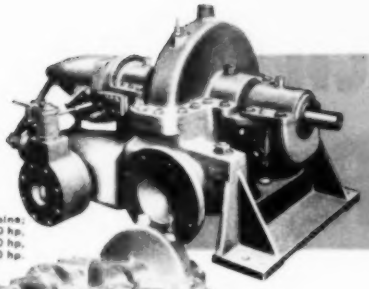
NIAGARA FALLS, N. Y. • TACOMA, WASH. • WILMINGTON, CALIF.

From the Pall of the Earth

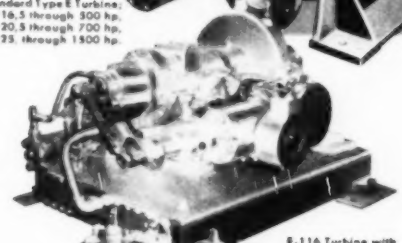
HOOKER® CHEMICALS

2-558

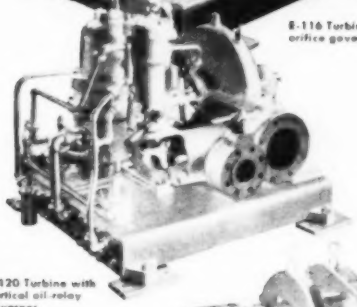
Take the *Guesswork* out of Turbine Selection!



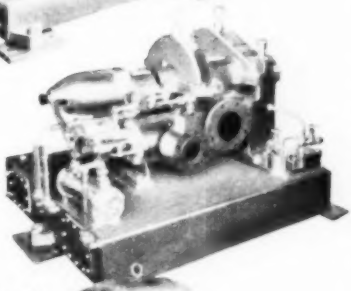
Standard Type E Turbine;
E-116, 5 through 300 hp.
E-120, 5 through 700 hp.
E-125, through 1500 hp.



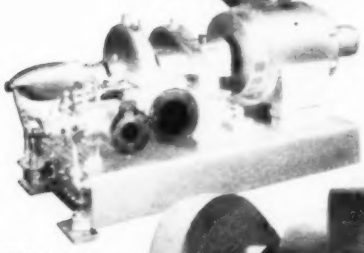
E-116 Turbine with orifice governor.



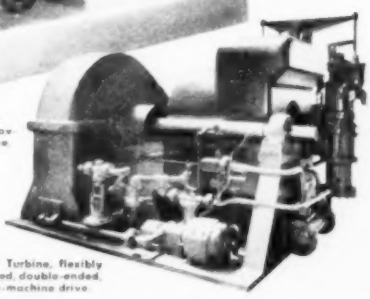
E-120 Turbine with vertical oil-relay governor.



E-116 Turbine, close-coupled gear; shaft governor.



E-120 Turbine, close-coupled gear; shaft governor—generator drive.



M-25 Turbine, flexibly coupled, double-ended, paper-machine drive.

Westinghouse General-Purpose Turbines can be supplied for mechanical or generator drive . . . either direct connected or geared . . . for condensing or noncondensing operation. This *complete* line . . . plus a nationwide staff of trained steam engineers, conveniently located sales offices, and service shops . . . assures you of the correct solution to *your* steam-drive application problem.

The single-stage Type E turbine, with designs for three basic classes of steam conditions, three wheel sizes and three standard governor types, provides in effect twenty-seven *standard, economical* variations to cover a wide range of applications. In addition, an almost limitless number of special applications can be met through the use of heavy-duty parts, and optional accessories.

Geared-turbine drives are offered either flexibly coupled to accommodate either right- or left-hand gear offsets, double-ended output shafts; or close-coupled (Gearturbines). Gearturbines are standardized on a single offset arrangement, affording utmost economy.

Other types in the complete Westinghouse general-purpose turbine line include heavy-duty and multi-stage units for applications requiring high temperatures and pressures, higher speeds, greater horsepower, extraction for process applications, or higher efficiency than may be had with single-stage machines.

The superiority of the Westinghouse line is the result of over 60-years' design, manufacture, and application experience. To get the benefit of this broad know-how, call your nearby Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-50552

YOU CAN BE SURE... IF IT'S

Westinghouse

GENERAL-PURPOSE TURBINES

How much does DuPont Research contribute to the Petroleum Industry?

FOR MANY YEARS DuPont research activities have *led* in the development of gasoline additives. It was a group of DuPont engineers and chemists who, in 1923, worked out the first safe, efficient method for making tetraethyl lead antiknock compound on a commercial scale. Since then DuPont has developed gasoline antioxidants, dyes and Metal Deactivator, as well as a number of grease stabilizers and fuel and lube oil additives.

AT PRESENT, the DuPont Petroleum Laboratory, the 5 DuPont Petroleum Chemicals Division district laboratories and the DuPont fleet of road test cars and trucks are constantly at work on the investigation of petroleum problems. In addition, the research facilities of the DuPont Company —including the DuPont Experimental Station—are available to supplement the work of the Petroleum Laboratory. And such DuPont products as neoprene, seismic explosives, tank farm paints and many other products widely used in the petroleum industry are also results of DuPont research.

FOR THE FUTURE, too, you can look to DuPont's recently expanded Petroleum Laboratory for new developments resulting from petroleum additives research.

DU PONT
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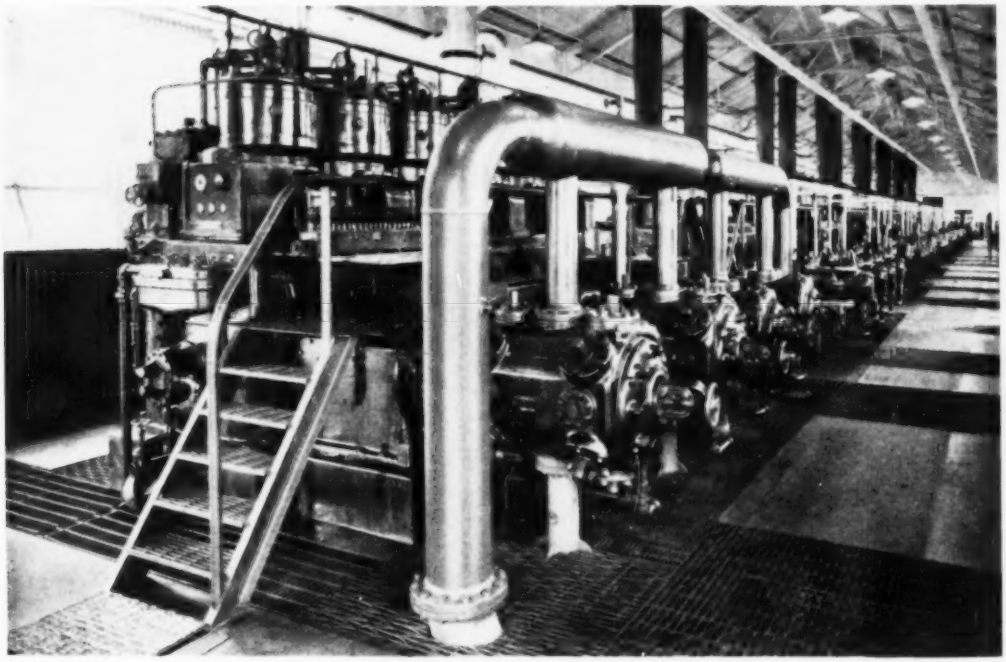
Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & CO., (INC.) • Petroleum Chemicals Division, Wilmington 98, Delaware

a mere .013" of power cylinder wear after 10 years' full-load operation



...that's Clark quality for you!

Clark "Right Angle" Compressors set remarkable record in Lion Oil Company operated Shuler Unit Natural Gasoline and Pressure Maintenance Plant

Power cylinder wear of less than .00125" per year after initial break-in! Total average wear of .013" per cylinder for the whole 10-year period!

. . . that's the remarkable record of six Clark RA-6, 600 bhp Right Angle, Gas-Engine-Driven Compressors operating continuously at full load since 1941 in Shuler Unit, Arkansas natural gasoline and pressure maintenance plant which is operated by Lion Oil Company.

But that's not all that's remarkable about this installation. The original power piston rings were in service for 8½ of those years before needing replacement.

Two other Clark RA-6 units operating since 1943 and 1948 respectively, are showing the same unusual resistance to wear . . . the same extremely low maintenance.

That's Clark quality and durability for you!

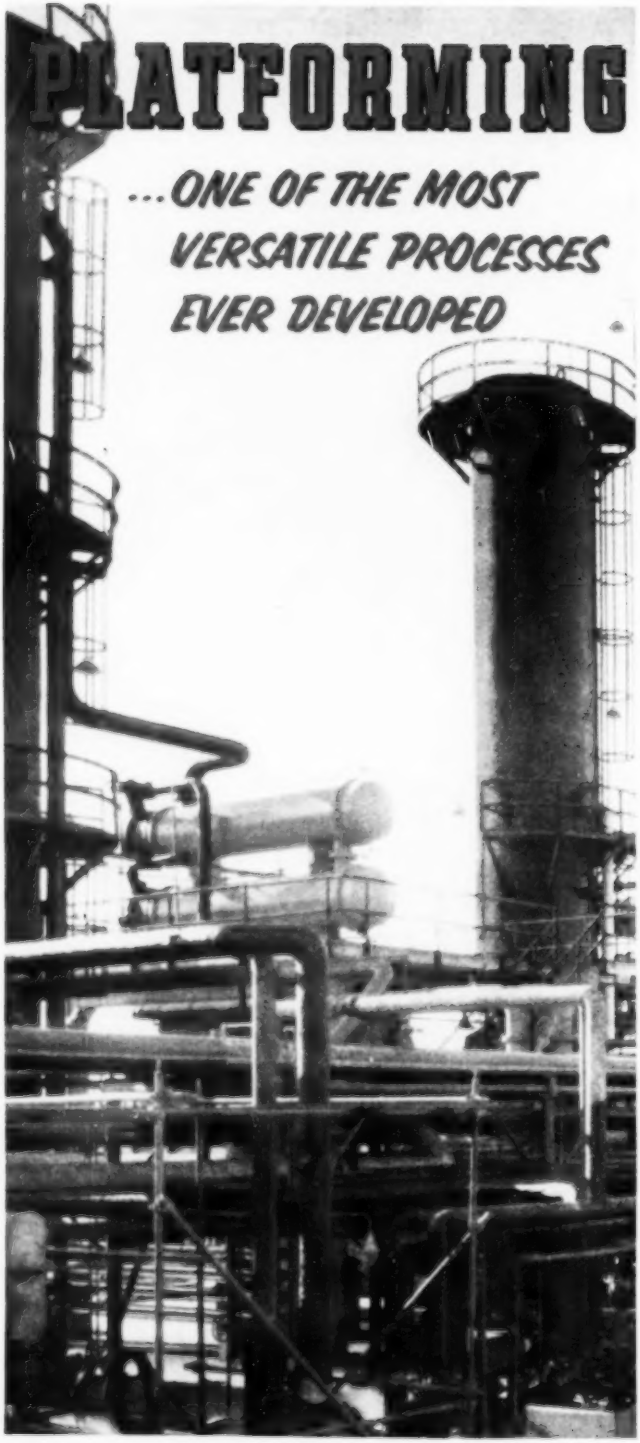
There's a BIG Difference in...

CLARK compressors

CLARK BROS. CO. • OLEAN, N. Y.

Division of Dresser Operations, Inc.

Offices in Principal Cities throughout the World



Eastern States Places Platforming and Udex Units In Operation

By R. B. Kahle

President,
Eastern States Petroleum
Company, Inc.

THE WORLD'S first commercial Udex unit was placed on stream at our Houston refinery April 2, 1952. It marked a major development in Eastern States' policy of building for the future.

R. B. Kahle

We have also recently installed a UOP Platforming unit which is presently providing the feed for the Udex unit. Both of these units were inspected at open house ceremonies at the refinery on the Houston Ship Channel on February 28.

The installation of these two new units puts Eastern States into the fast-growing petro-chemical industry where we feel we will be able to make substantial contributions to the rapidly growing demands for petro-chemical products.

4500 b/d Design Capacity

The new Platforming unit, which has a nominal design capacity of 4,500 barrels daily, is being used for the production of aviation gasoline base stocks. It charges a 330 degree dependumized straight run gasoline for avgas base production or a like amount of 400 degree straight run naphtha if the unit is to be operated for the production of high octane motor fuel.

In the operation of the Platforming unit, the full boiling range straight run gasoline charge is supplied to a prefractionation tower. This column is used to prepare the Platformer charge, taking the light fraction overhead, which consists essentially of pentanes and lighter, and removing a bottoms cut, thus leaving a naphtha fraction of controlled boiling range for reactor charge.

The reactor charge, taken as a sidecut from this column, is pumped by means of a centrifugal pump and this stream is joined with the recycle hydrogen gas before going into a heat exchanger.

Total feed is then passed through a heater to the No. 1 reactor where the reactions which take place result in a decline in reactant temperature.

The effluent from the No. 1 reactor is reheated in an interheater and is passed on to the No. 2 reactor where additional reaction takes place. The effluent from the No. 2 reactor is again heated and passed to the No. 3 reactor. The total effluent from this reactor after re-heating is sent to the No. 4 reactor.

Gas is then separated from the liquid in a product separator, with the bulk of the gas going to recycle gas compressors for return to the reactor section. Liquid from the product separator is charged to the stabilizer.

This stabilizing column is operated primarily as a depentanizer, C_5 and lighter being taken overhead, with full benzene retention in the bottoms. Bottoms are then fed to a dehexanizer column, where Udex feed is separated as an overhead fraction. This cut contains between 12 and 20 per cent benzene, depending on the quality of the charge stock and the operating conditions in the reactor section.

The Udex Unit

Eastern States' Udex unit is designed to charge about 1,000 barrels per stream day.

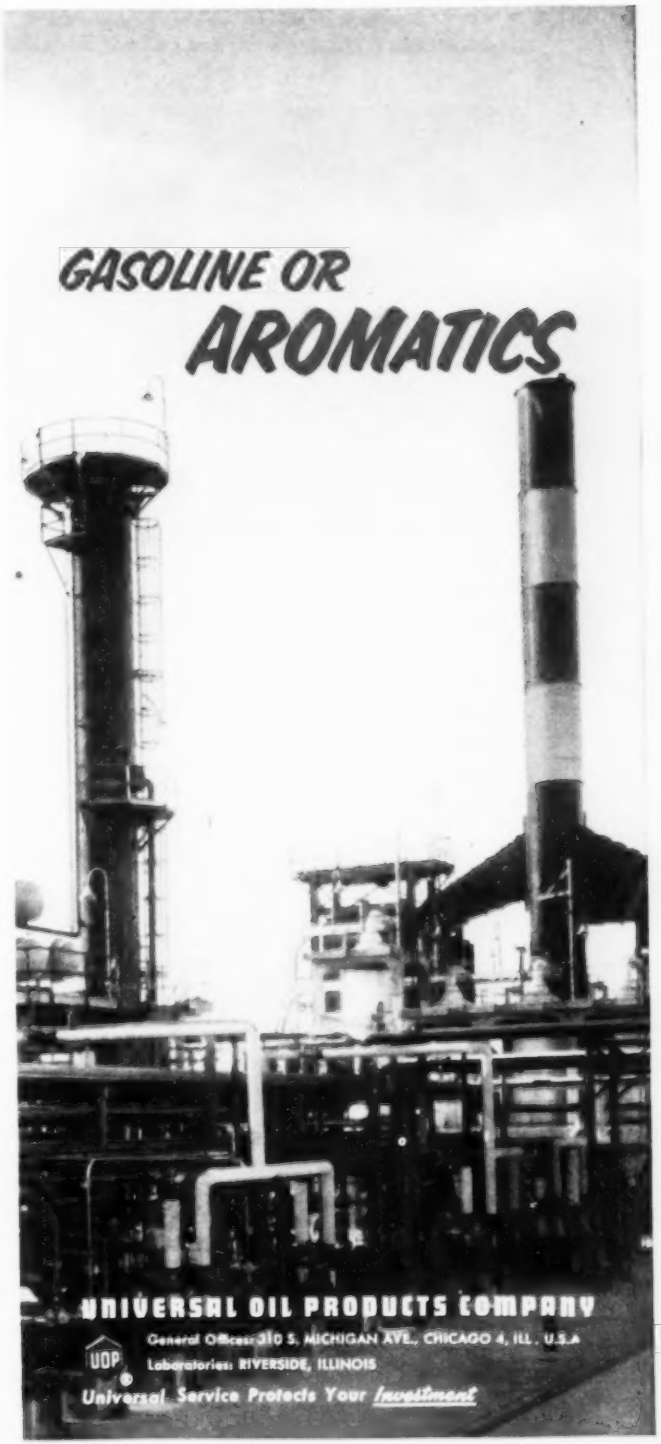
The feed to the Udex unit enters an extractor which employs an unusual tray design, especially developed for this process. In this column, the glycol solvent flows countercurrently to the feed. The solubility and selectivity of the glycol are controlled by water which is mixed in specific proportions with the glycol, resulting in excellent selectivity, a matter of prime importance in the Udex process.

The rich extract from the extractor is fed into a solvent recovery column in which the benzene is separated from the lean solvent which is returned to the extractor. The hydrocarbons from the stripper pass through a condenser to a receiver in which a two-phase system is established. The water phase, which also contains any glycol which has vaporized, is returned to the stripper.

Industrial Grade Benzene

The hydrocarbon phase is in part returned to the extractor as reflux, and the remainder provides feed to a fractionating tower from which industrial grade benzene is obtained as a product.

Eastern States believes that the installation of these two new units is another of the major steps forward which the company has taken in its 20 years of operation. Together with the new Rancho pipeline facilities which will be completed in the near future, these units place Eastern States in an enviable position — completely prepared to meet the demands of its customers in the petroleum and petro-chemical fields.



(To obtain more data on advertised products see page 1192)

ATTAPULGUS Fullers Earth
POROCEL Activated Bauxites

...two reliable names along the path of petroleum processing

WHAT DO YOU WANT TO PURIFY?

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils.

DO YOU HAVE CATALYST OR CATALYST CARRIER NEEDS?

Attapulgus or Porocel sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.

WHAT DO YOU WANT TO DRY?

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

SPECIAL GRADES?

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs welcome the opportunity of assisting in research, development, design and operating problems. Your inquiries are invited.

ATTAPULGUS CLAY COMPANY *Fullers Earth* • **POROCEL CORPORATION** *Activated Bauxites*

Dept. D, 210 West Washington Square, Philadelphia 5, Pa.

A New Achievement

.... in simplified, automatic Tank Gauging

"Varec" FIGURE NO. 2500 AUTOMATIC TANK GAUGE

FOR ALL TYPES OF LOW PRESSURE TANKS
READINGS UP TO 70 FT.

"VAREC", a pioneer in the development and manufacture of automatic tank gauging equipment has applied new fundamentals of design and operation to the Figure No. 2500 Gauge for the ultimate in accurate liquid level reading and dependable, trouble free operation.

Representing a major improvement with this new concept of simplified automatic tank gauge design, the "VAREC" Figure No. 2500 now utilizes the revolutionary Neg'ator Motor (Pat. No. 2,063,790) housed within the gauge head, to maintain a predetermined constant tape tension. This eliminates the need for a conventional counterweight.

Here's a Look Box You Can Read Easily, Accurately!

(Shown approximately ¾ actual size)

EASIEST TO INSTALL because:
Both counterweight and counterweight pipe have been eliminated. This permits installation of the look box at any desired height from the ground or on top of tank.

EASIEST TO READ because:
Full view Counter in the Look Box for quick, accurate reading of foot increments and a dial for reading inches and fractions. Use of large distinct numerals minimizes chance of reading errors. Eliminates calibrated tape.

EASIEST TO OPERATE because:
"VAREC" patented Gravity Compensator (Pat. No. 1879805) is incorporated with "inch reading" dial. An external Gauge Check device (Pat. No. 2555593) permits manual checking of gauge operation when desired.

EASIEST TO MAINTAIN because:
All internal parts of the Figure No. 2500 Look Box are non-sparking in contact with each other.
Non-corrosive Graphitar tape sheave bearings — self lubricating.

The "VAREC" Figure No. 2500 Automatic Tank Gauge is gas tight. It is adaptable to all types, arrangements and installations of low pressure tanks up to 70 feet in height. "VAREC" Figure No. 2500 Gauge Head is available as a separate unit and can be installed on existing float operated type tank gauges utilizing ¾" wide tape sheaves.

Provision has been made on the Look Box housing for installation *at any later date* of a "VAREC" Electronic Remote Reading Gauge Transmitter for use in conjunction with the various models of "VAREC" Electronic Gauge Receivers.

If you are not yet realizing the many time and money saving features and advantages of automatic tank gauging in your operations, install this new, simplified "VAREC" Figure No. 2500 Automatic Tank Gauge and start out ahead. Write or call your nearest "VAREC" Representative for all the facts.

Varec
PROVED—APPROVED

THE VAPOR RECOVERY SYSTEMS COMPANY
2820 N. Alameda Street, P. O. Box 231
Compton, California, U.S.A.

MAIL COUPON NOW FOR NEW BULLETIN CP-3500

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2820 N. Alameda Street, P.O. Box 231
Compton, California, U.S.A.

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Street and No. _____

City and State _____

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ENGINEERING INTEGRITY

● Wherever oil is refined — here in America and in the far places of the world — oil men recognize the McKee name as a symbol of engineering integrity.

Refiners know McKee as a source of sound, practical engineering that comes only from long experience and thorough, up-to-date knowledge. They know the conservative business methods which have always characterized this company's activities. They know McKee as an organization with the scope and resources to undertake any refinery project, large or small, and carry it through to completion with efficiency and integrity.

That's why so many refiners use McKee design, engineering and construction services again and again.

DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

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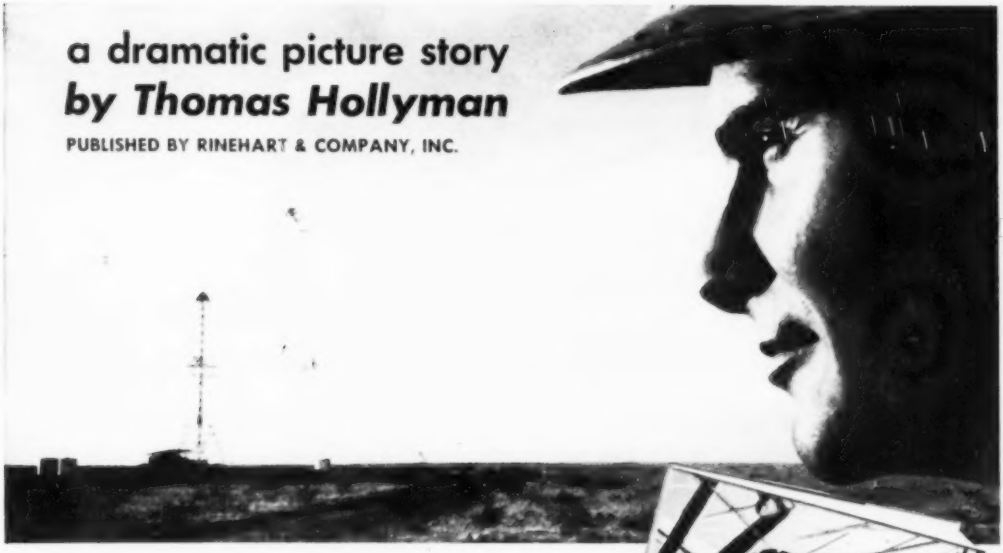
Headquarters: McKee Building, 2800 Chester Avenue, Cleveland 1, Ohio. *New York Office:* 30 Rockefeller Plaza, New York 20, N.Y. • *Washington Office:* 1507 M Street, N.W. Washington, D.C. • *England:* The Iron and Steel Division of Arthur G. McKee & Company is represented by Head, Wrightson & Company, Ltd. *District Engineering Offices:* Union, New Jersey and Tulsa, Oklahoma

It's your industry . . . It's your story . . . It's the book for you . . .

"The Oilmen"



a dramatic picture story *by Thomas Hollyman*

PUBLISHED BY RINEHART & COMPANY, INC.

It's a book you'll use hundreds of times —the picture story that captures the personality of an industry

● Consulting photographic editor of *Holiday*, and a contributor to other top magazines, Tom Hollyman now turns his lens on *oil*—to tell its exciting story in terms of the industry's men and women.

Dramatically photographed, concisely written, clothbound and oversize, "The Oilmen" tells petroleum's full story from search to discovery...through production, refining, transportation, marketing... to the ultimate user's door. It's a book the industry has needed for years, a book that every man and woman associated with petroleum must see, read, own.

$1.50 ACTUAL SIZE 10⅛" x 10½"

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Please send me ____ copies of THE OILMEN @ $1.50.
I enclose check or money order in the amount of $ ____

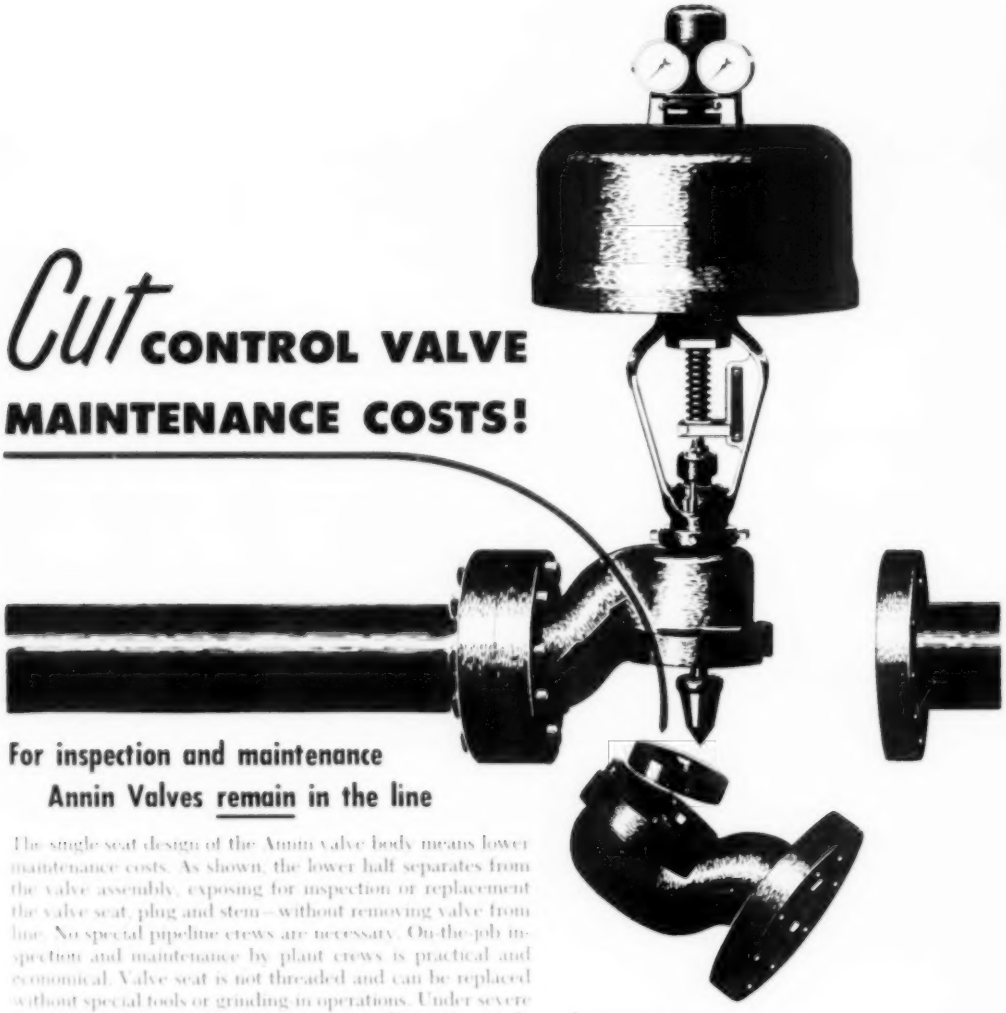
Name ____

Address ____

Shell Oil Company and its employees co-operated with Mr. Hollyman to make this picture story possible—and offer this announcement as a service to the men and women who have made oil the nation's No. 1 source of energy.

"The Oilmen," published by Rinehart & Company, Inc.

Cut CONTROL VALVE MAINTENANCE COSTS!



For inspection and maintenance Annin Valves remain in the line

The single seat design of the Annin valve body means lower maintenance costs. As shown, the lower half separates from the valve assembly, exposing for inspection or replacement the valve seat, plug and stem—without removing valve from line. No special pipeline crews are necessary. On-the-job inspection and maintenance by plant crews is practical and economical. Valve seat is not threaded and can be replaced without special tools or grinding-in operations. Under severe erosive and corrosive conditions lower half can be easily replaced at small cost compared to total valve investment. This cost-cutting feature applies to *all* Annin Valves—Domotor, Solenoid, and Handwheel types. All give the ultimate in precision *positive* control. If you are interested in lower maintenance, *and* operating advantages approached by no *other valve*—it will pay you to investigate Annin Valves.

Send for Annin General Catalog 1500B. Explains the exclusive Annin positive control Domotor action. Contains valuable cost-cutting hints, control valve application facts, flow formulas.

The Annin Domotor valves provide positive control of corrosive, erosive fluids and fluids containing semi-solids.

ANNIN CONTROL VALVES

For Dependable Flow Control
Specify POWELL VALVES

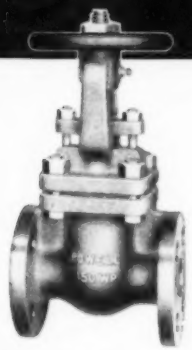


Fig. 2491—150-pound O. S. & Y. Gate Valve with precision-fitted, quickly interchangeable, solid or split wedge. Stem is threaded and guided through revolving bushing in upper yoke, which has a compression lubricant fitting. Available in a wide variety of corrosion resisting metals and alloys. Also made with screwed ends.

The amazing growth of the Oil Industry—not only in volume produced, but in the development of innumerable new petroleum products—has created a tremendous demand for all kinds of valves.

Powell, with extensive manufacturing facilities and an enviable background of making *dependable* valves, has met this issue squarely by supplying the right valves—both stock and special designs—to handle the flow of fluids in petroleum refineries and petro-chemical plants throughout the country.

Wherever oil, water, gas, steam or a corrosive fluid must be piped, there's a Powell Valve to control it to your complete satisfaction.

The Wm. Powell Company
Cincinnati 22
Ohio

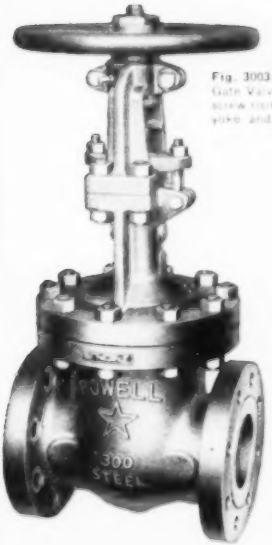


Fig. 3003—300-pound Cast Steel Gate Valve. Flange ends outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 375—300-pound Bronze Gate Valve. Screwed ends, union bonnet, inside screw rising stem and renewable Powellium® wear-resisting nickel-bronze disc.

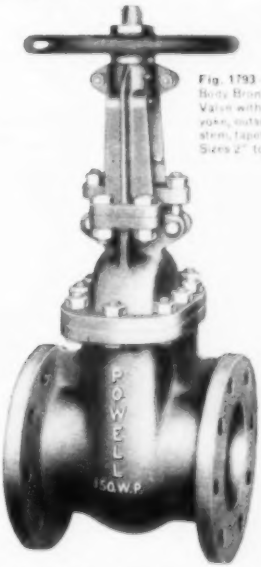


Fig. 2453-G—Large size 150-pound Stainless Steel O. S. & Y. Gate Valve with precision-fitted, interchangeable guided solid or split wedge. These are interchangeable. Made with separable yoke arms in sizes 5" to 30", incl. Conforms to all the latest standards. Available in a wide selection of other corrosion-resisting metals and alloys.

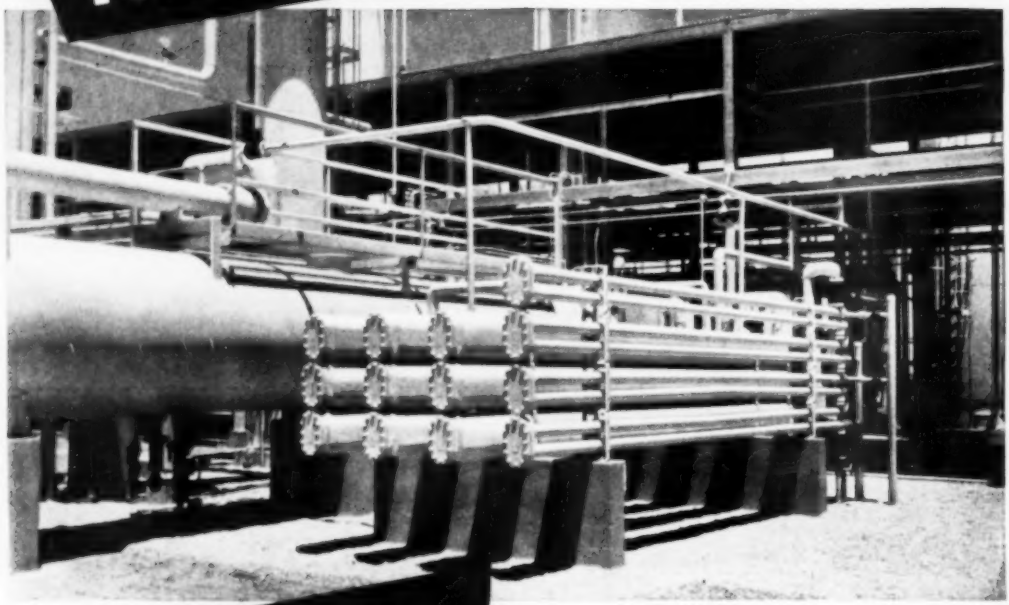
Fig. 1793—125-pound Iron Body Bronze Mounted Gate Valve with bolted flanged yoke, outside screw rising stem, tapered solid wedge. Sizes 2" to 30", inclusive.

Fig. 1561—150-pound Cast Steel Swing Check Valve with flanged ends and bolted cap.

POWELL VALVES

In Bronze, Iron, Steel and Corrosion-Resisting Metals and Alloys.

Assure Flexibility in your plant



with BROWN FINTUBE sectional hairpin heat exchangers

● You'll get almost unlimited flexibility to meet changes in duties, plant re-arrangements, etc., with Brown Fintube Sectional Heat Exchangers. By simply adding a few sections to your existing exchangers, or removing a few sections, or changing the series-parallel manifolding, change-overs can be made easily and quickly. You can be operating ***efficiently*** on almost any new or different duty, on short notice, with a minimum of expense for new equipment, and without obsoleting any of your former facilities.

For utmost efficiency and economy use Brown Fintube Sectional Heat Exchangers throughout your plant. ***Write for Bulletin No. 512.***

Sectional Hairpin Heat Exchangers
Tank Suction and Line Heaters
Fintube Heaters for Bulk Storage Tanks
Indirect Process Air Heaters
Fintube Heaters for Processing Tanks
Integrally Welded Fintubes for Any Heating, Cooling or Heat Transfer Service

THE BROWN FINTUBE CO.

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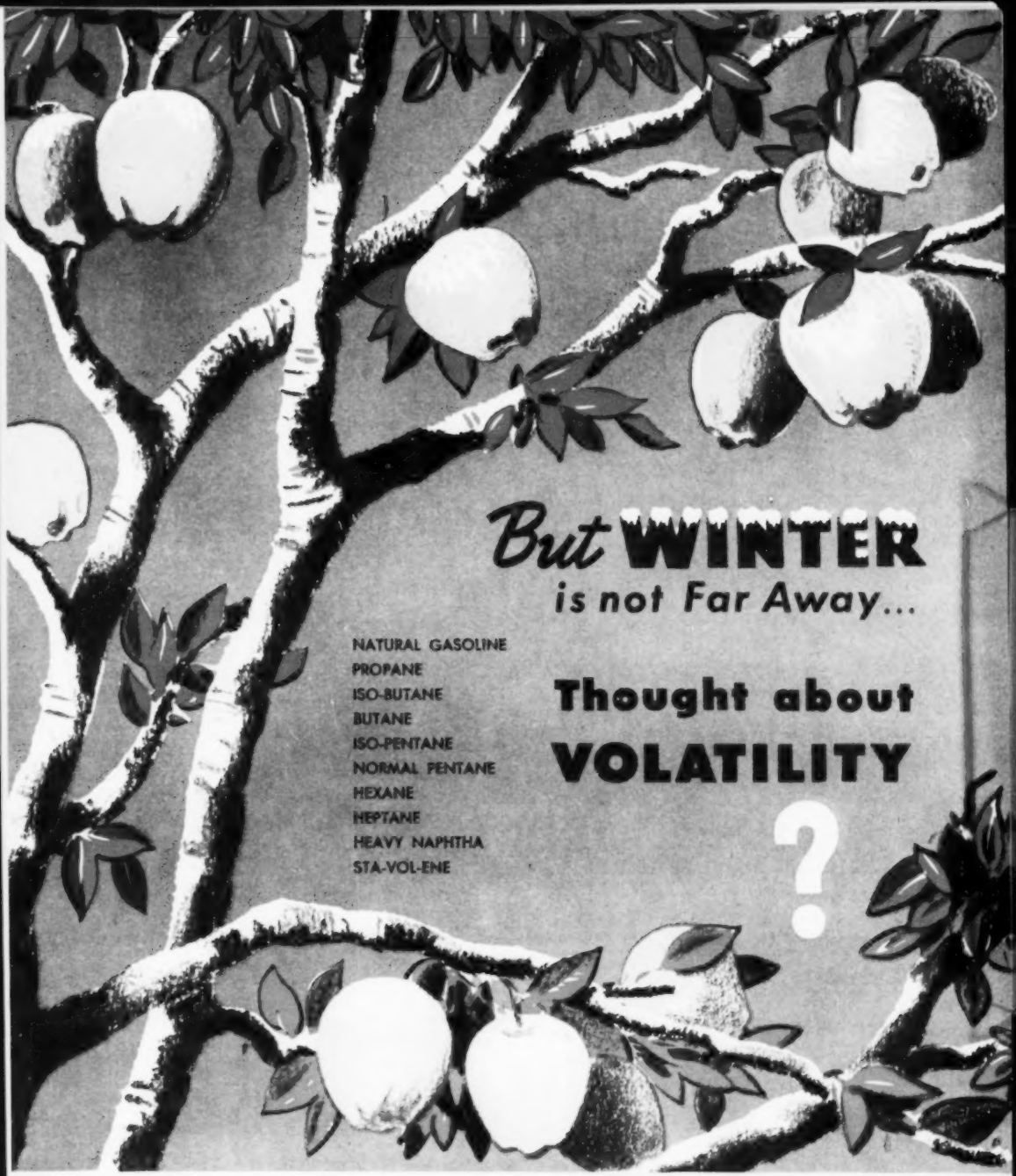


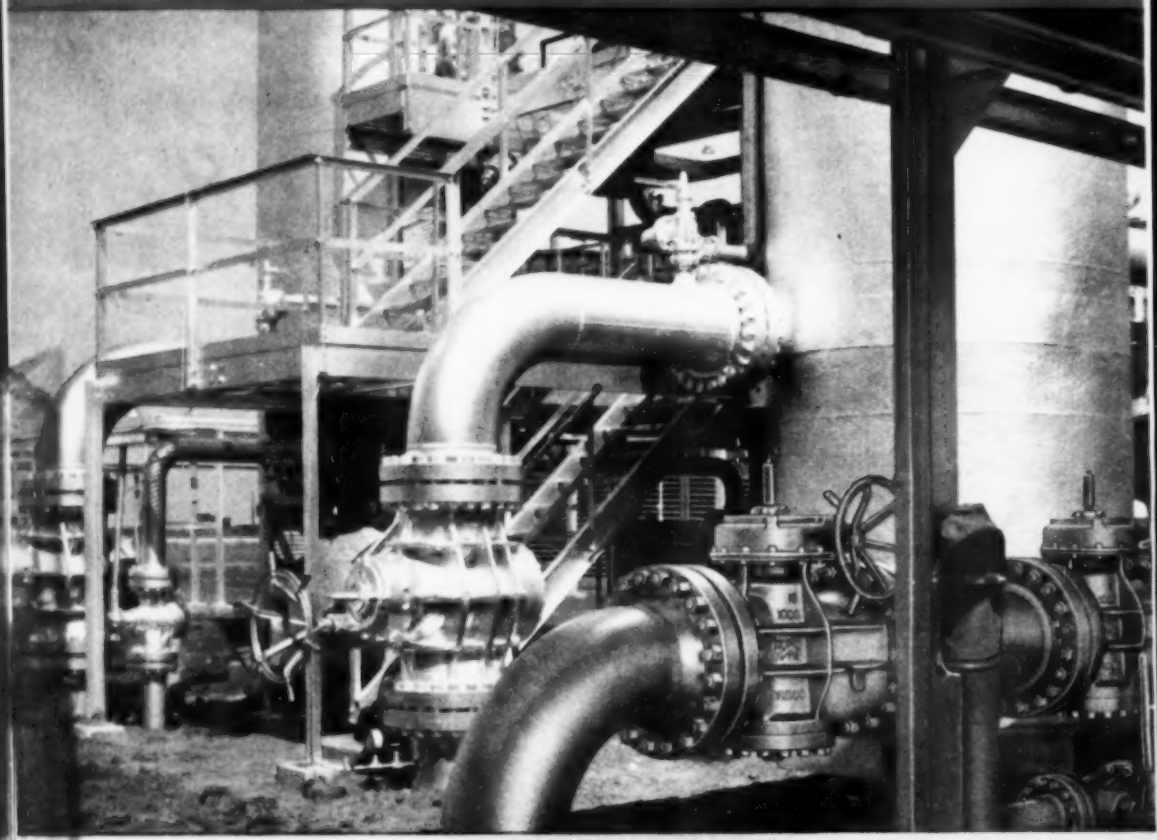
WARREN

PETROLEUM CORPORATION

TULSA, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

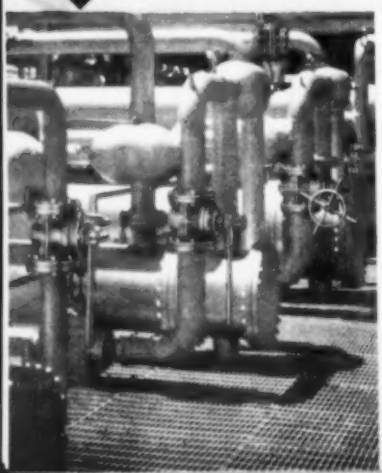
IT'S EASY TO FIT THE RIGHT

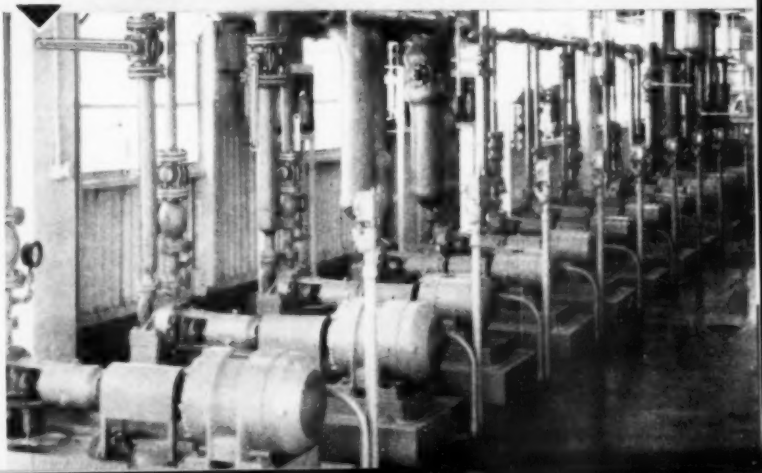


SPECIAL APPLICATIONS Nordstrom experience can tell you what special refinery applications you can successfully make with Nordstrom valves.

INSIDE OR OUT The same characteristics that make Nordstroms the most economical valves for unusual line conditions make them the best bet on inside equipment lines.

ALL SIZES There's a Nordstrom valve in the right size, the right pressure class, the right metals, the right end connection, and the right lubricant for nearly every refinery or gasoline plant service.





NORDSTROM VALVE TO *Gasoline Plant and Refinery Services*

With the background of several hundred thousand Nordstrom valves in refinery service around the world, Nordstrom engineers can help you select the best, most efficient designs for each type of refinery operation.

Nordstrom valves are especially suitable for refinery lines. The extra seal of plastic lubricant around the seat port area protects seating surfaces against line fluid, and at the same time gives a hydraulic jacking action for easy opening where line conditions cause many valves to stick.

For nearly all complex, hard-to-control refinery line fluids there are suitable Nordstrom valves. These are typical Nordstrom services:

HANDLING HYDROCARBONS—Loading rack, marine terminals, general transfer and run-down lines and other applications throughout the refinery where light hydrocarbons are the line fluid.

CHEMICAL TREATING—Handling treating acids, caustic, Doctor Solution, copper chloride and other reagents, in continuous or batching processes. Special metals are available.

LUBE OIL TREATING—Selective solvent treating of lube oils, including treatment with phenol, etc., along with the deasphalting of oils with propane, methyl ethyl ketone and other methods.

REFINERY GASES—In unit operations or compressor plants, Nordstrom lubricant-sealed valves are generally preferred.

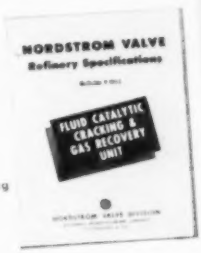
AVIATION GASOLINE PRODUCTION—Manufacture of alkylate for making high octane gasoline, either by the sulphuric acid process or anhydrous hydrofluoric acid process. Special metals, packings and flow area facings are available.

WATER SERVICES—Condenser service, water process lines and power plant lines.

AIR LINES—All types of air service lines.

PETRO-CHEMICAL MANUFACTURE—Examples: phthalic anhydride, isopropyl alcohol, synthetic glycerine, synthetic ethyl alcohol, napthenic acids and other petroleum based chemicals.

Now You Can Easily Fit Nordstrom Valves to the Specific Services in Your Specific Refining Process



So that refinery engineers can select the proper Nordstrom Valves for each service in the principal refining processes, a series of specification sheets showing recommended materials, pressure classes, lubricants and valve figure numbers has been prepared. There is a special Nordstrom Specification Bulletin for each of these processes:

- Catalytic Polymerization
- Crude Topping and Vacuum Distillation
- Cycloversion
- Delayed Coking
- Distillate Recovery in Cycling Plants
- Duo-Sol Solvent Extraction
- Fluid Catalytic Cracking and Gas Recovery
- Girbotol Process
- Houdriflow Catalytic Cracking and Gas Recovery
- Hydroforming Process
- Light Ends Fractionation
- Naphtha Polyforming
- Phenol Extraction
- Propane Deasphalting
- Propane Dewaxing
- Solexol Process
- Solvent Dewaxing
- Thermal Cracking
- Thermal Reforming

A Nordstrom service engineer will be glad to review these specification sheets with you. Call your nearest Rockwell office or write to Rockwell Manufacturing Company, 400 N. Lexington Ave., Pittsburgh 8, Pa.

IMPORTANT NEWS for NORDSTROM HYPRESEAL VALVE USERS

Now Nordstrom Hypreseal valves can be lubricated by hand gun, bucket pump or manually ***without interchanging parts.*** The new Rockwell Fitting, a combination lubricant screw and giant button head fitting, is now furnished at no additional charge with all Nordstrom Hypreseal valves. This new feature saves you the expense and bother of purchasing fittings for hand gun or bucket pump lubrication. Contact your Nordstrom representative for further details.

There's an oil field supply store with Nordstrom Valves and Nordstrom Service as close as your telephone.

Rockwell Built

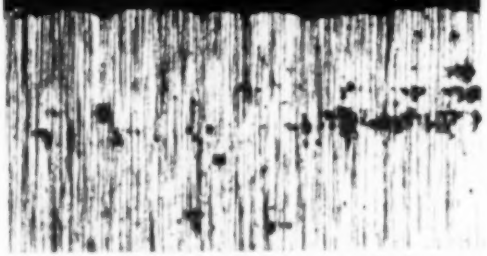
Another ROCKWELL Product

Nordstrom Valves

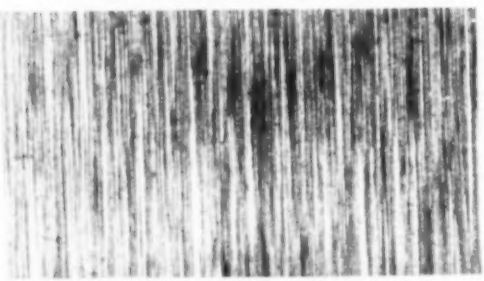
Lubricant Sealed to Keep Upkeep Down

ROCKWELL MANUFACTURING COMPANY
400 N. Lexington Ave., Pittsburgh 8, Pa.

HERE'S *Positive Control* OF PITTING AND TUBERCULATION



Pitting with conventional treatment at 18 magnifications



Lack of pitting, Dianodic Method, at 18 magnifications

A complete report on the Dianodic Method of cooling water treatment. Ask for Technical Paper No. 123.

FOR years, industry has sought a method of chemical treatment that would provide *complete* protection against corrosion, pitting and scale in cooling water systems. Many present day methods for corrosion prevention do effect some decrease in metal loss, but unless excess treatment concentrations are used, localized attack in the form of pitting continues with ultimate metal failure.

Realizing the importance of this major problem, Betz Laboratories has developed the Dianodic Method, an advanced water treatment technique that assures *complete* protection. In this method, the combination of two anodic inhibitors under correct concentration and pH has proved time and again to control pitting and tuberculation, which conventional treatment is unable to control even at much higher concentrations. What's more, the Dianodic Method provides increased protection against general corrosion.

Here's what happened in one refinery which has a circulation rate of 10,000 gpm on its "cat" cracker system. The temperature drop through the tower is 15° F., with closed heat exchangers used for cooling purposes. Inspection of the system after ten months operation with conventional type treatment revealed freedom from scale and general corrosion, but *serious* pitting and tuberculation. Heads of the exchangers were deeply pitted and tubercles were built up to a height of 3 inches. The edges of the end around baffles were severely pitted and required "filling in" by welding. The Betz Dianodic Method was employed and after ten months the results were outstanding. Not only was scale and corrosion controlled, but pitting and tuberculation were eliminated entirely. The welded baffle ends were in perfect condition with the original welding marks clearly visible!

The development and successful field application of this new method of cooling water conditioning is just one example of the outstanding engineering service offered by BETZ. Why not let a Betz Engineer show how you can improve operating efficiency and cut costs in your plant? Write today. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

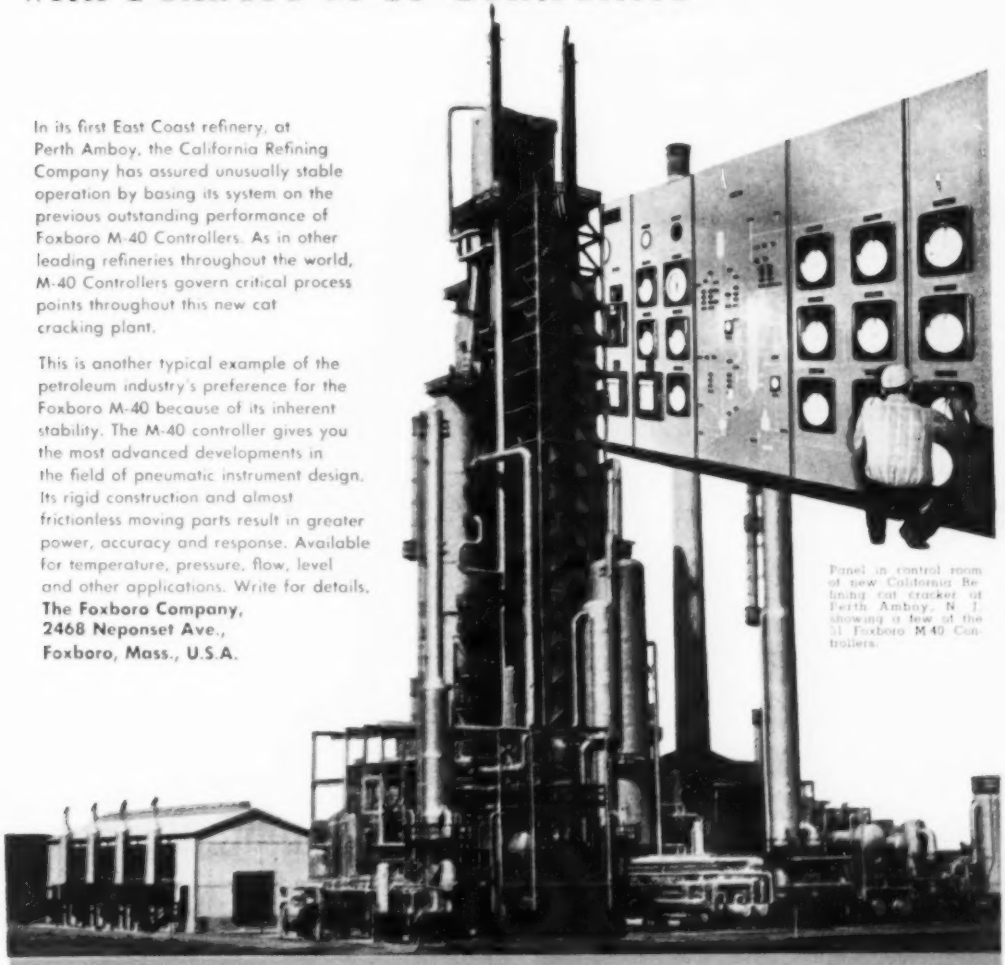
Cal. Refining

"Cashes-in" on past experience with Foxboro M-40 Controllers

In its first East Coast refinery, at Perth Amboy, the California Refining Company has assured unusually stable operation by basing its system on the previous outstanding performance of Foxboro M-40 Controllers. As in other leading refineries throughout the world, M-40 Controllers govern critical process points throughout this new cat cracking plant.

This is another typical example of the petroleum industry's preference for the Foxboro M-40 because of its inherent stability. The M-40 controller gives you the most advanced developments in the field of pneumatic instrument design. Its rigid construction and almost frictionless moving parts result in greater power, accuracy and response. Available for temperature, pressure, flow, level and other applications. Write for details.

The Foxboro Company,
2468 Neponset Ave.,
Foxboro, Mass., U.S.A.



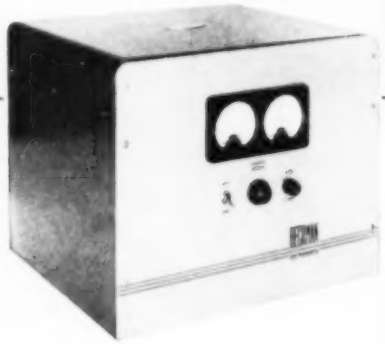
Panel in control room of new California Refining cat cracker at Perth Amboy, N. J., showing a few of the 51 Foxboro M-40 Controllers.

FOXBORO CONTROLLERS

Reg. U. S. Pat. Off.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

This BATTERY POWER REGULATOR allows the Beckman DU Spectrophotometer to operate Indefinitely without Battery Drain!



Designed for use with the Beckman DU Spectrophotometer, this battery power regulator is mounted in an attractive gray hammertone metal case with meter and controls on the front panel. The case will accommodate a standard storage battery *and the six C batteries included in the DU*. In addition, the Regulator includes one C battery to permit the needle of the DU to always be driven full scale.

In operation a built in charging unit supplies exactly the same amount of current to the storage battery as the instrument draws from the storage battery, thus making the current output so constant that drift of the instrument due to the battery is eliminated. It is furnished with a cable assembly for readily connecting the regulator unit to the terminal strip underneath the DU and to the new liquid cooled lamp housing or to the old style lamp house, dry cell C battery $7\frac{1}{2}$ volts, kit of insulators and spacer block and set of instructions and circuit diagram.

H-59502—Beckman Battery Power Regulator, Each **$240.00**

Photomultiplier Attachment Greatly Increases the Sensitivity and Resolution of the DU Spectrophotometer

The Photomultiplier Attachment is an accessory for use with the DU to permit increased sensitivity over the range 220 to 650 millimicrons. It consists of an auxiliary battery box for all DU dry cell batteries and a special housing for a IP28 photomultiplier tube. The attachment is very simple to install, and it includes necessary parts and directions for doing so. In operation the photomultiplier tube and the 22 megohm resistor are used for all measurements below 600 mu, the red sensitive phototube with the 10,000 megohm or 2000 megohm resistor is used for analysis above 600 mu. These combinations are selected with two panel controls. In operation the Photomultiplier Attachment increases the sensitivity of the Model DU Spectrophotometer at least one hundred times and enables maximum resolving power to be realized. Slit widths down to .01 mm can be employed to minimize interferences and increase accuracy of all measurements. This increased sensitivity and high resolving power is particularly desirable for flame photometry, fluorescence and turbidimetric measurements.

H-59514—Beckman Photomultiplier Attachment, Each **$375.00**

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DIVISION OF THE HARSHAW CHEMICAL CO.
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ENGINEERED DESIGN BY **HAMMEL-DAHL**

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Outstanding Control Valve Features originated by Hammel-Dahl

1. The "DAHL SEAL"® — a frictionless, leak-proof Valve stem SEAL — for any static pressure.
2. ALLSTEEL Superstructure.
3. Bolted packing box — standard.
4. Forged fabricated bonnets and blind heads.
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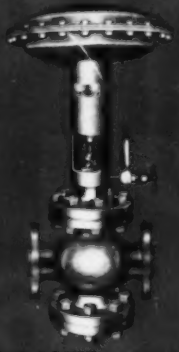
6. Stainless steel spring stem — standard.
7. Oilite Bearings, friction-free.



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DAVISON DEPENDABLE CATALYSTS BUILD BETTER MOTOR FUEL

The operating efficiency of synthetic fluid-type cracking catalysts is important. This operating efficiency can be assured by uniformity of physical characteristics and chemical purity. Davison's production of microspheroidal (M-S*) is tops in uniformity . . . providing all users with a highly efficient synthetic fluid-type cracking catalyst. Your requirements can also be supplied in ground (DA-1*) form. Write for further descriptive information. Experienced Davison Field Service Engineers backed up with complete laboratory testing facilities are part of Davison's service.

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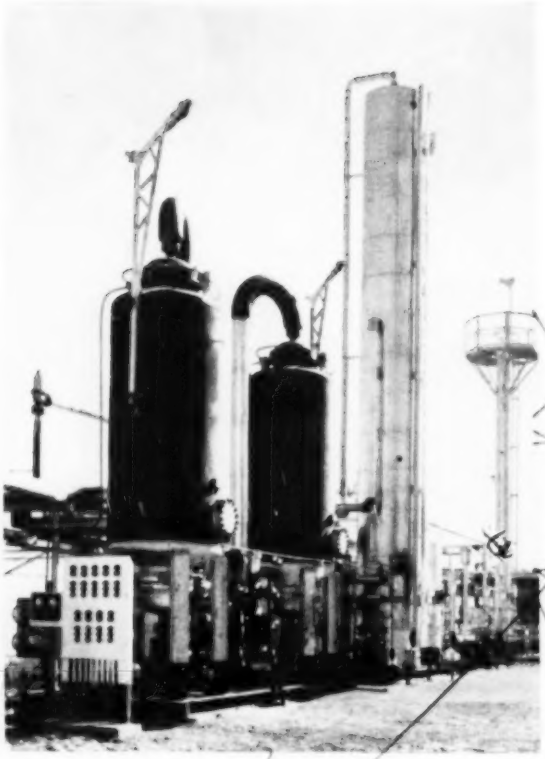
PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS, SILICOFLUORIDES AND FERTILIZERS



PERCO*

CYCLOVERSION* AT PALESTINE, TEXAS

Inland Refining Company recently put this 850 barrel per day Cycloversion unit on stream reforming straight run gasoline.

Engineering by Grebe & Doremus Process Co., Houston, who partially shop fabricated this unit on three skids for more rapid installation.

Write us about Cycloversion for you.

Phillips 66

Perco Division **PHILLIPS PETROLEUM COMPANY** *Bartlesville, Oklahoma*

*A SERVICE MARK

HAYNES Alloy Sheet and Plate

Trade-Mark

Evaporators

Autoclaves

Agitators

Pickling Equipment

For SEVERE SERVICE conditions

You can obtain sheet and plate of four different HAYNES alloys, all specially designed to combat certain severe service conditions, for the fabrication of processing equipment. The alloys are all strong and highly resistant to heat, oxidation, and chemical corrosion. The chart below will give you an idea of where each is most commonly used.

HAYNES alloy sheet and plate have been used successfully for many different types of fabricated equipment. Typical applications include reaction vessels, condensers, autoclaves, heat exchangers, evaporators, dryers, mixers, agitators, fans, and blowers. The alloys can be fabricated by deep drawing, spinning, pressing, forming, and welding.

All four HAYNES alloys are supplied in hot-rolled sheet and plate in thicknesses of 1 in. down to 24 U. S. Std. (0.025 in.). These materials are furnished annealed and pickled with a commercial No. 1 finish. If you wish further information about HAYNES alloy sheet and plate, contact the nearest Haynes Stellite Company district office.

USE SHEET OR PLATE OF	FOR RESISTANCE TO
HASTELLOY Alloy B (nickel-molybdenum-iron)	Hydrochloric acid, wet hydrogen chloride gas, sulphuric acid, phosphoric acid, organic acids, high temperatures.
HASTELLOY Alloy C (nickel-molybdenum-chromium-iron)	Nitric acid, free chlorine, acid salts, hydrochloric acid, sulphuric acid, phosphoric acid, organic acids, sulphurous acid, high temperatures.
MULTIMET Alloy (cobalt-chromium-nickel-iron)	Oxidation, high temperatures.
HAYNES Alloy No. 25 (cobalt-chromium-tungsten-nickel)	Oxidation, high temperatures, carburization, wet chlorine, nitric acid.

HAYNES alloys

TRADE MARK

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A Division of

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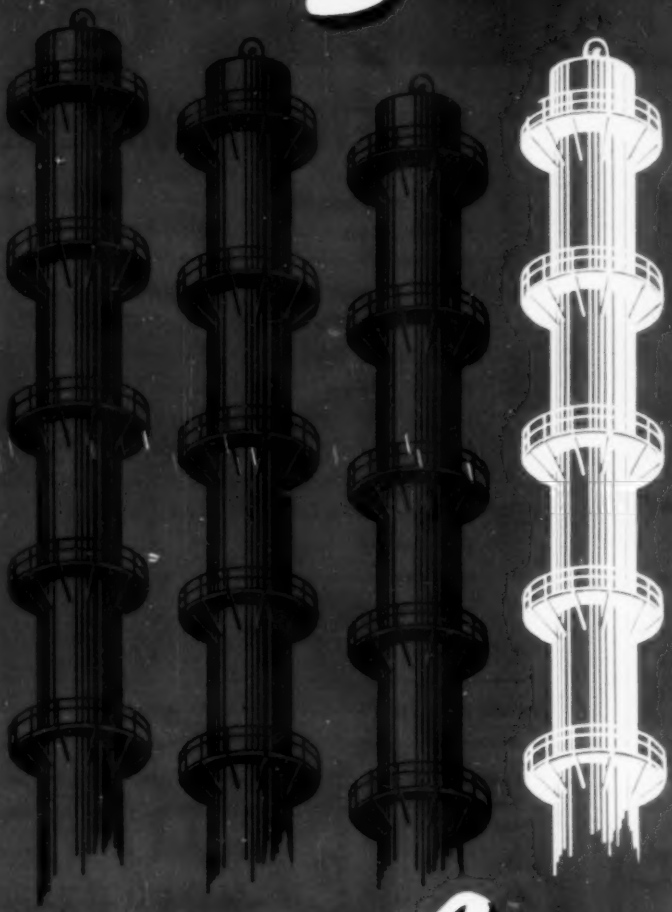
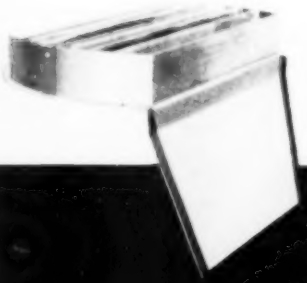
YOU CAN MAKE 3 TOWERS



DO THE WORK OF 4

When you think of more capacity, forget additional towers. Your present towers, equipped with Koch Kaskade trays, may provide the additional capacity at a fraction of the cost.

Write us today, advising us of your existing tower sizes, the vapor and liquid capacities you desire, and we'll tell you what you can obtain with Koch Kaskade trays.



KOCH ENGINEERING COMPANY, INC.

IMMEDIATE DELIVERY

From Stock

fully armored all-metal FLOWRATOR meters

Delivery right from Fischer & Porter stock in Chicago, Dallas, Los Angeles and Hatboro means much to you.

Now you can have the wide range, linear scale Fig. 52 all-metal meter quickly in 150 lb. and 300 lb. ratings in steel or 316 stainless. These meters are complete meters and not just metering elements, are low in price and may be equipped with Magnabond pneumatic transmitters (illustrated) or all-metal magnetic indicators which are regularly stocked. Six sizes in FLOWRATOR Meters will cover a capacity range from a *fraction* of a GPM (or SCFM) to 240 GPM (or 850 SCFM). Each meter, with Stablvis float, has a viscosity immunity well above that found in orifice practice.

Further, Fig. 52 meters can be changed for different applications—right in the field—by use of the information contained in the F & P Variable Area Handbook.

If you would like further information on Fischer & Porter Flowrator Meters—or a free copy of the Variable Area Handbook—check and return the handy coupon now!

5 DISTINCT FEATURES:

- One moving part, no stuffing box
- Wide rangeability
- Viscosity immunity
- Linear calibration
- Safe, all-metal construction

Fig. 52 Flowrator Meter equipped with Magnabond pneumatic transmitter.

FISCHER & PORTER COMPANY
1150 COUNTY LINE ROAD, HATBORO, PENNA.

☐ Please send me by return mail complete information on your Armored Flowrator Meters.
☐ Please send Variable Area Handbook.

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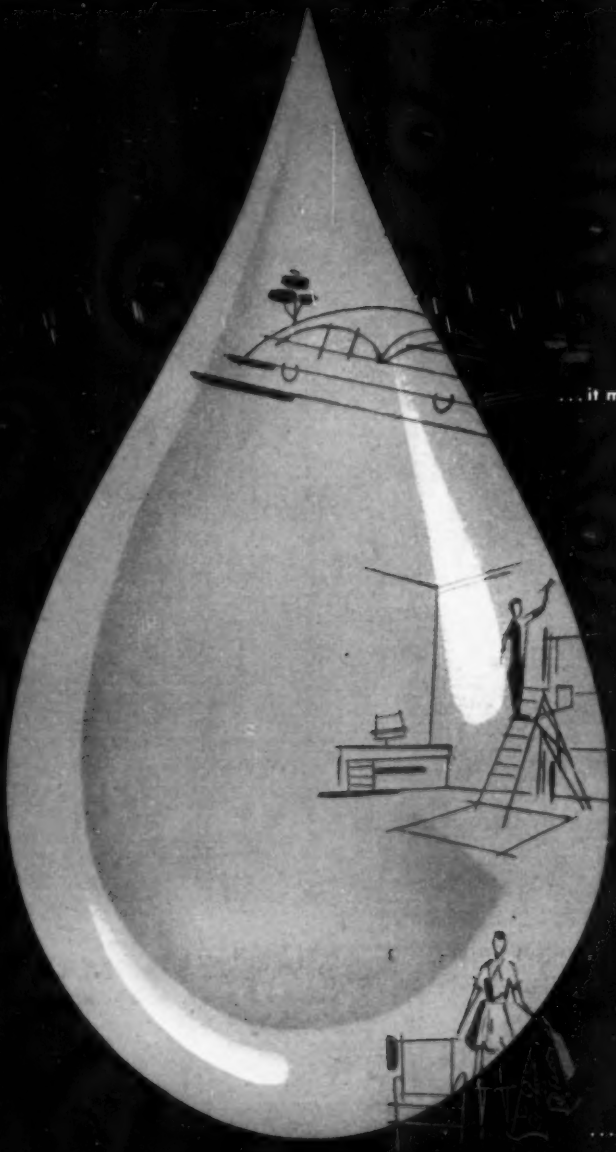
THIS DROP of petroleum



. . . it may drive your car

. . . decorate your home

. . . or dress your wife

now means TWO great industrial markets

...now completely covered by ONE publication designed to serve both the refining and petrochemical fields

Once chiefly the source of fuel for your car, petroleum now supplies the chemicals for everything from plastics to textiles, from detergents to soil restorers.

In fact, you can hardly wake to a new day that does not find the booming petrochemical industry bringing new comfort, convenience or economy into your life.

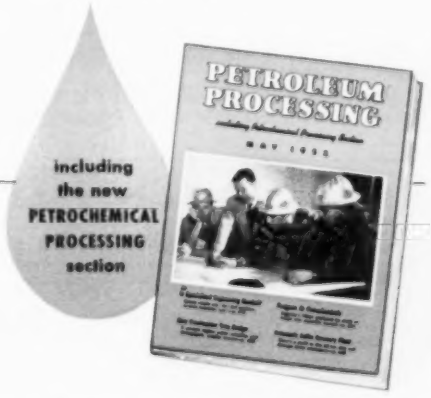
Petroleum Processing is the magazine that has been fully alert to the progress of this youthful industry growing up within an industry. It has been edited on a dual basis, for those engaged in petroleum refining and for those pioneering in petrochemistry.

Now, with its special monthly *Petrochemical Processing Section*, it serves this sensationally expanding field to a greater degree than any other single publication.

As an advertiser in *Petroleum Processing*, you can reach this twofold market which, according to the U. S. Department of Commerce, exceeds all other industrial markets in dollar expenditures for plant expansion in 1952. You can have the attention of more than twelve thousand key men; the opportunity of selling this group slated to spend billions within the next few years.

Write today for the current and complete list of petrochemical plants, yours without obligation. Start your salesmen calling. Back them up with an advertising schedule in the only magazine that can give you adequate coverage of *both* the refining and petrochemical fields.

Petroleum Processing, 1213 West Third Street, Cleveland 13, Ohio. Offices in New York, Chicago, Philadelphia, Houston, San Francisco and Los Angeles



Petroleum Processing

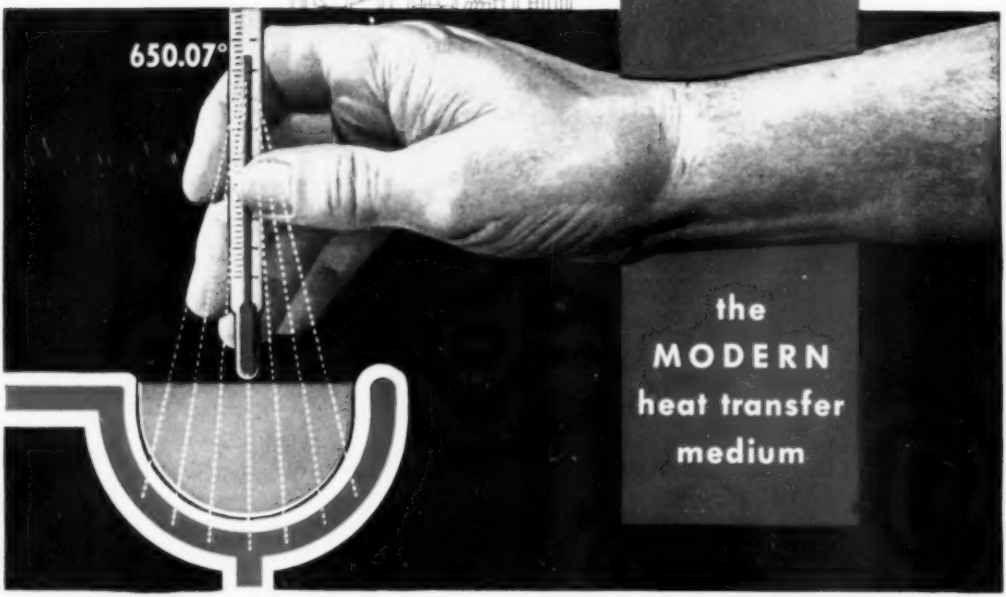
A Platt Petroleum Publication

FOR THE MEN WHO ARE MAKING MIRACLES WITH PETROLEUM

NBP ABC

the heat is on right . . .

DOWTHERM



MAINTAINS UNIFORM HEATING OVER ENTIRE PROCESSING SURFACE

Here's the best answer to the precise temperature control required in petroleum fractionation—DOWTHERM®. This material, a stable organic heat transfer medium, is used in a closed system in the same manner as steam but it offers *low pressures* at temperatures from 300°F. to 750°F. Thus, in this temperature range, carefully controlled and uniform heating is available, hot spots and overheating will be eliminated and the coking problem diminished.

Several pieces of equipment can be held at different constant temperatures by one DOWTHERM system, or if alternate heating and cooling are required—DOWTHERM also should be considered in your system.

If you need constant high temperatures at low pressures write Dow for complete DOWTHERM information.

ATTENTION PROCESS MEN . . . Use DOWTHERM . . . for heating and reboiling naphthas, kerosene, gas and oil, and for the production of special products . . . also for recovery systems of solvent refining units.

THE DOW CHEMICAL COMPANY
Midland, Michigan

The Dow Chemical Company, Dept. DO 24
Midland, Michigan

Please send me *"The Dowtherm Story"*

Name _____ Title _____

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3 ways B-L can help you with a castable lining for catalytic equipment

Engineering

Today, the same high-caliber engineering that pioneered the use of suspended linings for refinery furnaces is available to you for castable linings, too. This new B-L innovation is designed to give you a serviceable, yet economical enclosure for catalytic equipment—vessels, lines, cyclones, stacks and ducts.

Materials

Two proven A.P. Green Fire Brick Company materials—SK-7 and KS-4—combine to provide an enclosure adaptable to abrasion, corrosion or heat problems. Various thicknesses of these factory-mixed insulating cements are "gunned" over meshes to form a smooth monolithic wall.

Erection Help

It all adds up to a single co-ordinated source for the three elements of a vessel lining or heat enclosure job. In addition to high-level engineering and job-tested materials, B-L is prepared to offer erection service. It all adds up to *one complete package—one contract and one responsibility.*

WRITE FOR YOUR COPY OF THIS NEW BOOK:

"One Source", a new B-L catalog, is yours upon request. No obligation, of course.

BIGELOW-LIPTAK

Unit-Suspended Walls & Arches

BIGELOW LIPTAK Corporation

2550 W. GRAND BLVD. • DETROIT 8, MICH.

IN CANADA

BIGELOW-LIPTAK OF CANADA, LTD., TORONTO, ONTARIO

ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MINNEAPOLIS • NEW YORK PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

How would YOU solve these two problems?

POSITIVE BRAKE-ACTION, so essential to public safety, is aided by use of the Permafuse Corporation's special brake-bonding oven. Installed in progressive service stations, the Permafuse oven fuses the adhesive-coated brake lining to the brake shoe evenly and permanently. A low-cost, rugged THERMOSWITCH® unit keeps oven temperature constant for proper bonding and keeps service calls to a minimum.

PREVENTION OF SPOILAGE in refrigeration applications is a matter of constant, exact temperature control. In the Jewett Hospital Blood Bank, for example, temperature is maintained at 37° F within plus or minus 2 degrees. Two Fenwal THERMOSWITCH thermostats serve as an alarm device, warning instantly against freezing or refrigeration failure if temperature goes below 32° F or above 48° F.

A FENWAL THERMOSWITCH CONTROL may solve your problem, too. Its external, single-metal shell expands or contracts instantly with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of problems where heat is a factor.

SEND FOR THIS CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal, Incorporated, 108 Pleasant Street, Ashland, Mass.

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*

The practical way to save pipes, tanks, derricks, buildings, pumps, roofs, fences

STOP RUST! with RUST-OLEUM

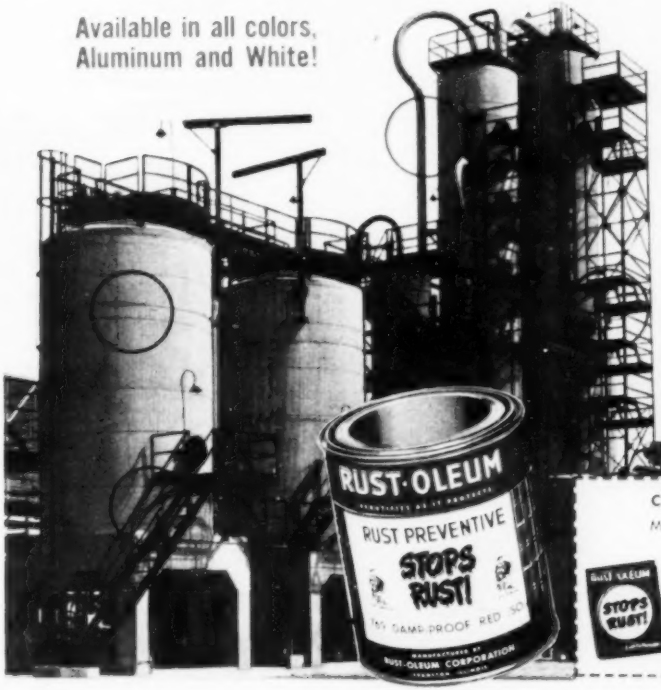
RUST-OLEUM is the *practical, sensible* answer to your rust problems. Cuts your maintenance costs, because it may be applied *directly over rusted surfaces* after wirebrushing and scraping with sharp scrapers to remove rust scale and loose particles . . . costly sandblasting and chemical pre-cleaning are not usually required. This often enables *one man* to do the work of two with RUST-OLEUM! Practical, too . . . because RUST-OLEUM beautifies as it protects in *all colors, aluminum,* and *white.*

We'll be happy to show you convincing proof that RUST-OLEUM can cut your maintenance costs . . . and last longer when applied over rusted surfaces. Get the facts, today! Prompt delivery from Industrial Distributor stocks in principal cities in the United States and Canada.

RUST-OLEUM CORPORATION
2479 Oakton Street, Evanston, Illinois

May be applied directly over rusted surfaces without removing all the rust!

Available in all colors, Aluminum and White!



Dries to a tough, elastic coating that resists fumes, moisture, heat, weathering, most acids and chemical dusts

CLIP THIS TO YOUR LETTERHEAD
Mail To: Rust-Oleum Corporation
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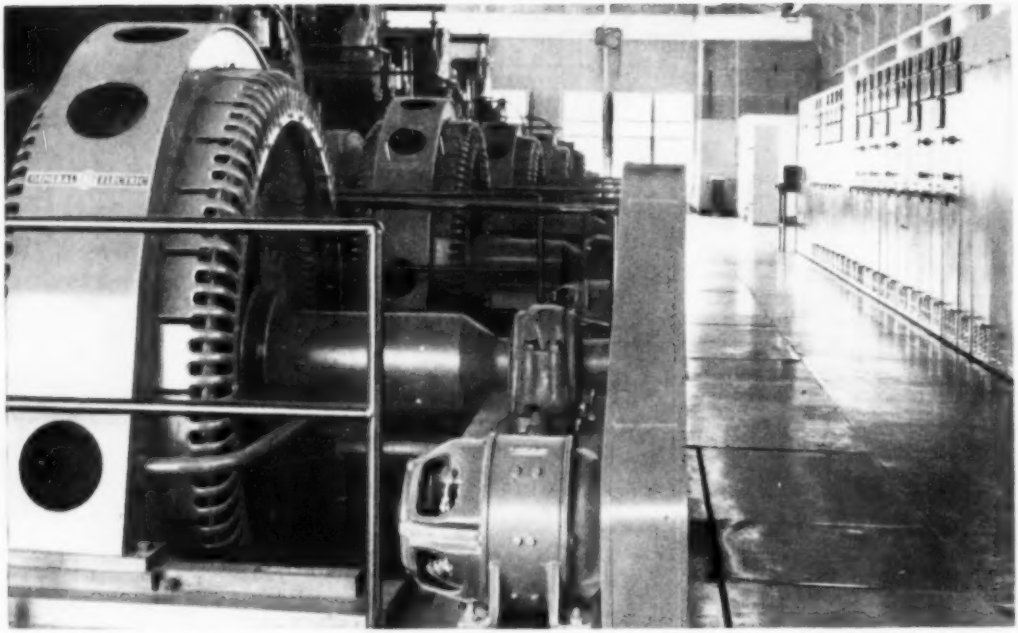
Evanston, Illinois

- ☐ Have A Qualified Representative Call
- ☐ Full Details On Free Survey
- ☐ Complete Literature
- ☐ Nearest RUST-OLEUM Source

Electrically co-ordinated for efficient gas stripping!

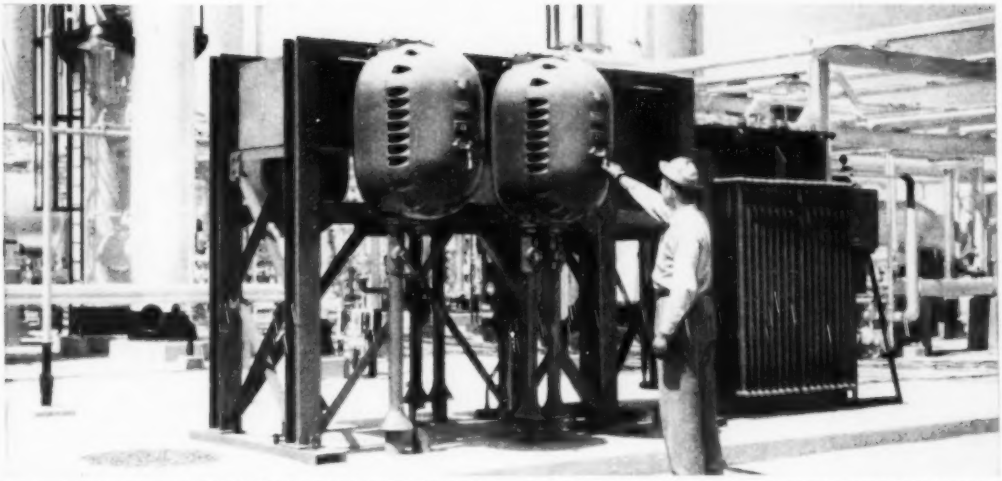


Supplying all power for Standard's North Cowden plant are these five G-E gas engine driven 800 kw a-c generators, with provision made for three more when needed. Power plant also includes (right) the main G-E 4160-volt metal-clad switchgear.

In hazardous refinery areas, use of explosion-proof motors—like these four G-E Tri-Clad® explosion-proof units at North Cowden—eliminates need for specially constructed rooms, permits locating motors for convenience and space economy.

Co-ordinated
ELECTRIC EQUIPMENT
for Gas Repressuring and Natural Gasoline Plants

Increase your workers' efficiency with General Electric's new Motor Selection and Application Course. A G-E "More Power to America" program, it gives the essentials on motors in 9 easy-to-take lessons. Bulletin GEA-4938-16 describes the course in detail. Write for it—now!



For high service continuity, eight G-E 500-kva load-center substations serving low-voltage circuits are arranged for secondary selective operation. In hazardous areas, substations are equipped with explosion-proof breakers as shown here.

New G-E equipped gas repressuring plant maintains continuous output in processing separator gas

Stanolind Oil and Gas Company's gasoline plant at North Cowden, Texas, is designed to efficiently process 100 million cubic feet per day of separator gas (now equipped for 50 million cubic feet per day) for the recovery of 300,000 gallons daily of propane, butane, and gasoline. Part of its efficiency is due to the electric apparatus supplied by General Electric, co-ordinated throughout by close engineering co-operation with Stanolind and its contractors. Ask your G-E representative how your refinery's electrical needs, too, can be met by G-E's skill in application engineering and project co-ordination. *General Electric Co., Schenectady 5, N. Y.* 66-98

To meet refinery conditions, G.E. builds an extremely wide line of explosion-proof equipment. These three G-E 15-hp explosion-proof vertical motors, for example, are also equipped with explosion-proof Start-Stop push buttons.

In non-hazardous areas, refineries favor grouping low-voltage motor controls for easier maintenance, as with these G-E 440-volt Cabinetrol* units at North Cowden. Compact and standardized, they save space, cut installation costs.

GENERAL ELECTRIC

Crude heater at Continental Oil Company, Ponca City, Oklahoma, using a Ljungstrom Air Preheater.

Refineries Now Using the Ljungstrom Air Preheater on One or More Process Units

Continental Oil Company
Humble Oil & Refining Company
Interocean Oil Company
Le Conselho Nacional de Petroleo Ref.
Lion Oil Company • Ohio Oil Company
Richfield Oil Corporation
Sinclair Refining Company
Socony Vacuum Oil Company
Standard Oil Company of California
Standard Oil Company of Indiana
Standard Oil Company of New Jersey

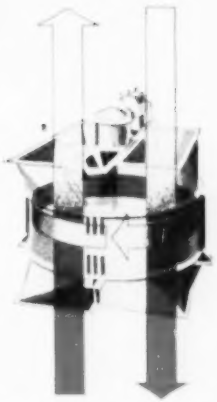
The Ljungstrom is no stranger to refineries. For years it has been a standard item for utilizing waste heat from power and process steam boilers. These refiners now use Ljungstrom Air Preheaters on steam boilers

Cit-Con Oil Corporation • Continental Oil Corporation
Esso Standard Oil Company • Humble Oil & Refining Company
Magnolia Petroleum Corporation • Pan American Refining Company
Phillips Petroleum Company • Shell Oil Company
Standard Oil Company of Indiana
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey • The Pure Oil Company
The Texas Company • Tidewater Associated Oil Company
Wilshire Oil Company

To obtain more data on advertised products see page 1192

..... *with the*

Ljungstrom Air Preheater



The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

In every refinery vessel that burns fuel, air preheat shows the way to save as much as *one barrel out of every five*. In view of the 200,000,000 barrels of fuel refineries burn every year, this means the *Ljungstrom Air Preheater* can recover tens of millions of *production dollars* that are now going up the stack.

The Ljungstrom removes precious BTU's from exit gases and transfers them to combustion air. Its effectiveness can be gauged from the fact that every 35-40 F of preheat means roughly a 1% saving in fuel costs – and Ljungstroms now in service preheat air to well over 600 F.

In addition to saving as much as 20% of your fuel, more effective fuel utilization means that your equipment can deliver greater throughput . . . can burn lower grade fuels with less slagging . . . lets you eliminate convection surfaces without reducing production.

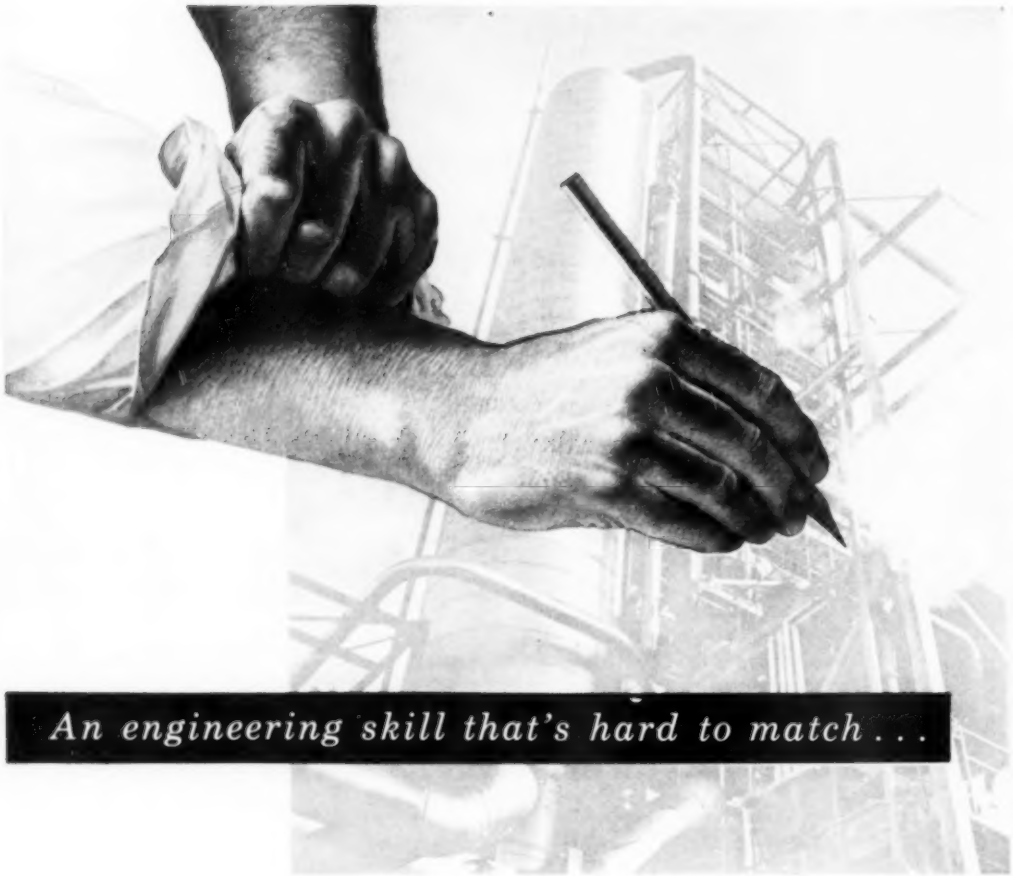
In these days of high fuel costs, every refinery should consider the Ljungstrom for new installations or modernization of existing equipment. Call or write The Air Preheater Corporation for full details.

Wherever You Burn Fuel, You Need Ljungstrom

Consider Ljungstrom Air Preheaters for . . .

Catalytic Cracking
Coking
Petrochemical Production
Petrochemical Separation
Petrochemical Synthesis
Polyforming
Propane Deasphalting
Reforming
Solvent Refining
Thermal Cracking
Visbreaking

THE AIR PREHEATER CORPORATION
60 East 42nd Street, New York 17, N. Y.



An engineering skill that's hard to match . . .

We mean the skill that's acquired after rolling up sleeves 600 times or more—to design and construct that many petroleum refining, petroleum chemical and chemical plants at sites all over the world.

These plants didn't just happen. Lummus men had ideas, practical imagination, the ability to work, a sharp sense of responsibility, and a company policy which placed no limit upon the physical facilities needed to do the job.

All this is worth its weight in gold—an appraisal which our clients express time and again. We see it as a healthy "atmosphere" in which new processes, new techniques, new equipment and new products are developed to our own high standards, and to the satisfaction and profit of our customers.

So we offer this suggestion: put us down as a group with the depth of chemical engineering talent and the breadth of experience to tackle *your* next engineering and construction project—whatever and wherever it may be. And to do it with a skill that's hard to match.

LUMMUS

THE LUMMUS COMPANY

385 MADISON AVENUE, NEW YORK 17, N. Y.

HOUSTON • CHICAGO • LONDON • PARIS • CARACAS

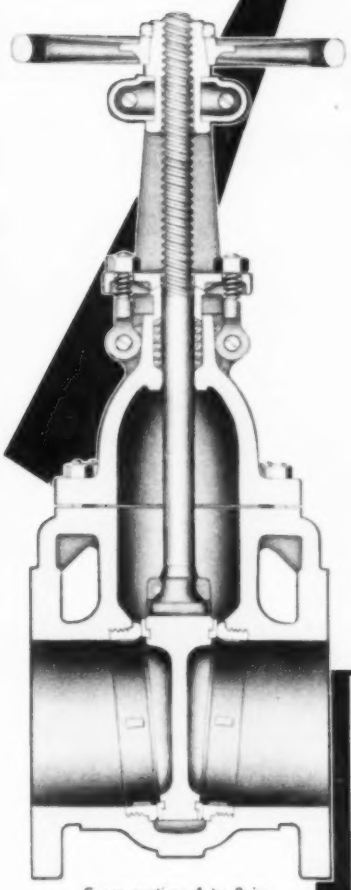
DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

cut the high cost of corrosion

IN MANY SERVICES...WITH

CRANE *Ni-Resist*

CAST IRON GATE VALVES



Cross-section 4 to 8 in. sizes; bolted bonnet joint; flanged ends.

Here is a line of "cast iron" gate valves with a special talent for resisting corrosion, erosion and wear. Use them with safety where the strength of ordinary cast iron is adequate—in soda and sulfate pulp mill service—on creosote lines in wood treating processes—for handling sour distillates and crudes in petroleum refining—and many similar services.

Clue to the extra staying-power of Crane Ni-Resist Cast Iron Valves is in their make-up (approximately 14% nickel, 2½% chromium, and 6% copper)—and in their 18-8 Mo Alloy Steel stem and seating faces. Not to be overlooked is the fine Crane design that gives you a strong body and bonnet without excessive weight, a well-proportioned stem with precision-cut threads, a sturdy yoke, and the dependable disc-stem connection that assures smooth operation and tight seating of the solid wedge disc. Ask your Crane representative for full details, or see your Crane Catalog.

THE CRANE NI-RESIST LINE

Working Pressures:
Cold Water, Oil, or Gas, Non-shock
Screwed Valves—225 pounds
Flanged Valves—200 pounds

Available in sizes ½ to 8 in. All have solid wedge disc, with outside screw and yoke. Sizes ½ to 3 in. have clamp type bonnet joint and one-piece bolted gland. Sizes 4 to 8 in. have conventional bolted bonnet joint and two-piece bolted gland.

No. 1671 with Bolted Bonnet Joint. Flanged ends only. Sizes 4, 6 and 8 in.

No. 1670 with Clamp Type Bonnet Joint with screwed ends. Sizes ½ to 2 in. Also with flanged ends 1 to 3 in.

The Complete Crane Line Meets All Valve Needs. That's Why **More Crane Valves Are Used Than Any Other Make!**

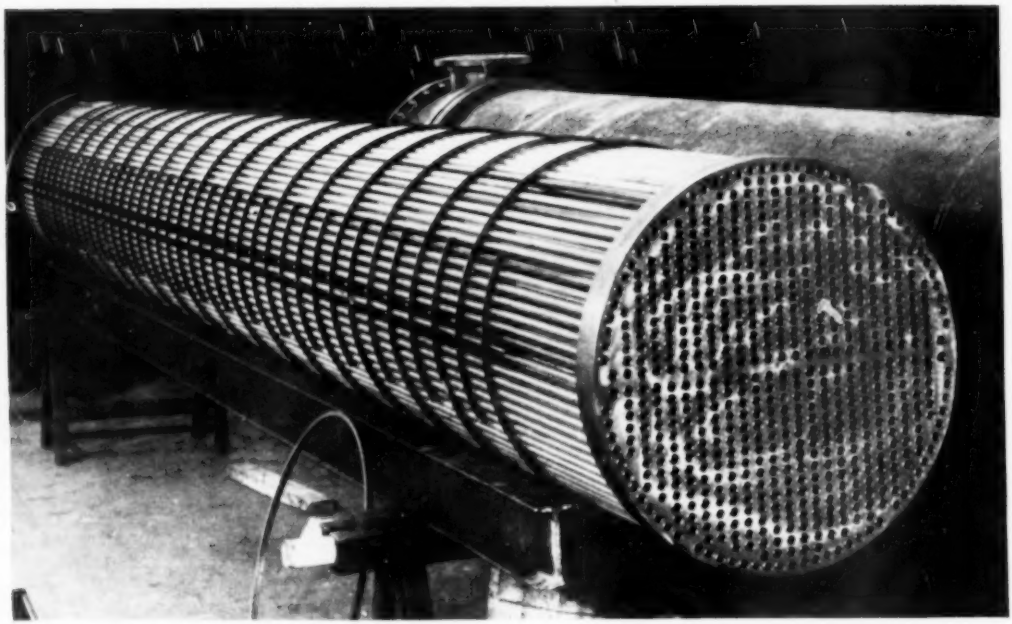
CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

for cooling lube oil
economically
they use the oil industry's
favorite tube alloy

ARSENICAL ADMIRALTY-439
Tubes (⅝ in. O.D. x .049 in. x 16 ft.) were used in this heat exchanger—898 lengths! Kewanee-Ross Corporation made it to cool lubricating oil in a hot strip mill. Here, where corrosive and erosive factors are only moderately severe, this alloy was selected as the most economical.

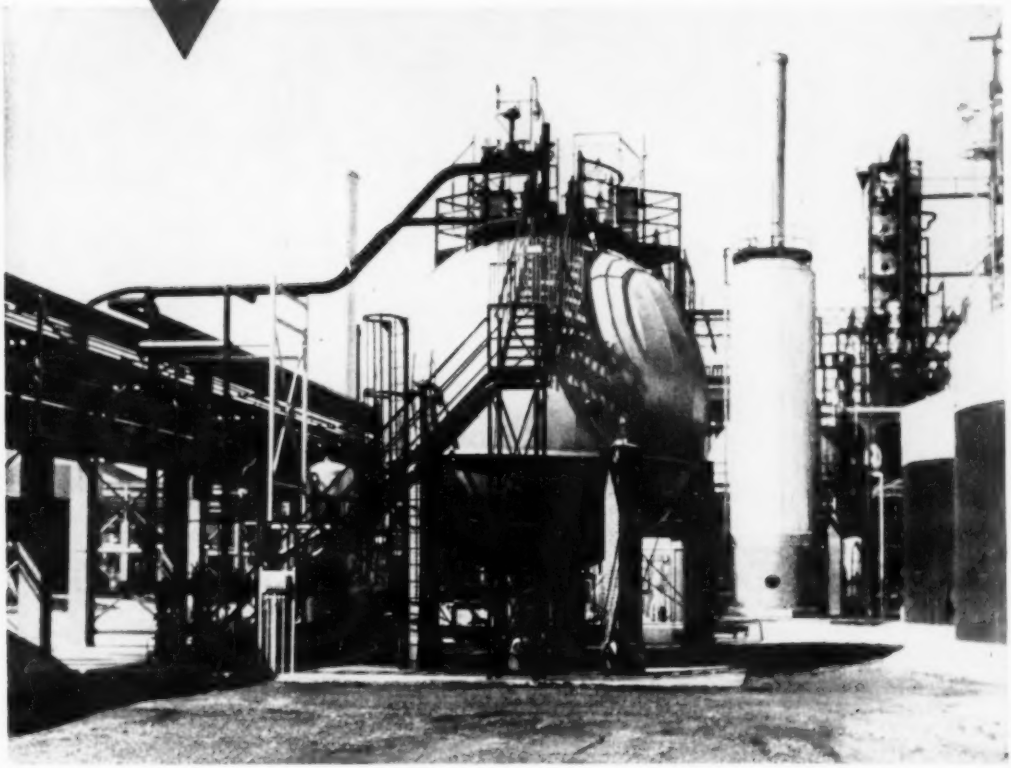


WHY REFINERIES CHOOSE THIS ALLOY — Arsenical Admiralty-439 is the standard tube alloy for condensers and heat exchangers handling crudes, re-run stocks, cracked products, lubricating oils and by-products. It satisfactorily resists gas streams from both sweet and sour crudes (with or without neutralizers), general corrosion, and also dezincification. This latter feature makes it ideal for handling corrosive cooling waters at relatively high temperatures.

CASE HISTORIES — Anaconda's Technical Department has accumulated extensive data relating to the actual performance of copper alloys. It is always prepared to use this practical knowledge to assist you in selecting the right alloy for your application . . . to help you get longer tube life at lower operating cost. For this service write The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 3208

for efficient heat transfer—ANACONDA® condenser tubes

CONOCO *another leading refiner who desalts with PETRECO*



CONTINENTAL OIL COMPANY is now using Petreco Desalting in four different refineries,—New Mexico, Oklahoma, Texas and Louisiana. Four successive installations by a refining organization with Conoco's established reputation is ample evidence that Petreco Desalting proved itself once for Conoco, and has continued to do so with each successive installation. If you want the best in salt removal performance, specify Petreco and be assured of

Minimum Residual Salts and Solids
Reduced Furnace Plugging
Maximum Exchanger Efficiency
Reduced Corrosion in Topping Section
Savings in Salvaged Waste Oil
Consistently Clear Water Bleed
Trouble-free Automatic Operation

PETRECO OFFERS COMPLETE DESALTING SERVICE AND FACILITIES

PETROLITE CORPORATION
PETRECO DIVISION

3202 S. WAYSIDE DRIVE, HOUSTON 3, TEXAS
1390 E. BURNETT ST., LONG BEACH 5, CALIF.

PETRECO

ELECTRIC PROCESSES FOR THE PURIFICATION OF PETROLEUM

CRUDE OIL: REMOVAL OF SALTS, SOLIDS AND OTHER IMPURITIES; DEHYDRATING
DISTILLATES: ACID, CAUSTIC AND DOCTOR TREATING
FUEL STOCKS: DESAPONIFICATION

PR 52-6

A NEW PICTURE OF SOUTHWESTERN

REFINERY ENGINEERING Company is proud to have been chosen by SOUTHWESTERN OIL and REFINING COMPANY to modernize their plant at Corpus Christi, Texas.

The contract calls for the construction of a Universal Oil Products Company Catalytic Cracker, Gas Concentration Unit and Polymerization Units and Product Treater. Designed capacity will be 5,740 barrels gas oil charge per day at 50% conversion. The plant will burn 4,350 pounds of coke per hour at designated throughput.

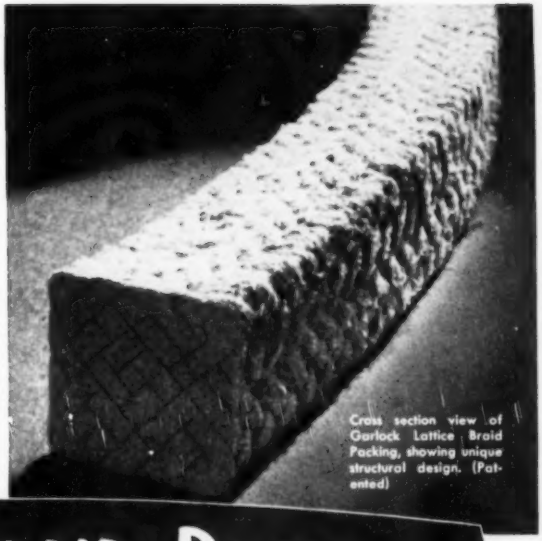
The two most common bottlenecks encountered, when increased production is desired, have been eliminated by making the initial capacity of the blower 30% greater than required for the carbon burned at design conditions and installing a fractionating column one foot larger in diameter than required for design capacity. At a later date throughput can be increased to the ultimate capacity of the blower and tower by changing pumps and adding heat exchange surface.

Call on Treco for a discussion of your refining problems and requirements. You will find that our constantly expanding staff of engineering, design, construction and operating men can give you the correct answers and show you how to save time and money. Treco plants are designed to give you the utmost in efficiency and flexibility at a minimum of cost.

REFINERY ENGINEERING *Company*

PHONE 5-5561 • TULSA, OKLAHOMA

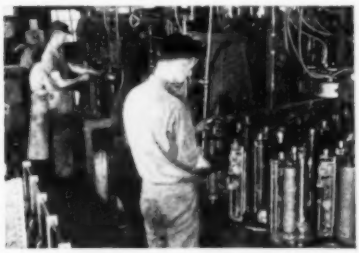
For Long Trouble-Free Service USE



Cross section view of Garlock Lattice Braid Packing, showing unique structural design. (Patented)

LATTICE-BRAID PACKING

GARLOCK 751 (cotton) Lattice-Braid Packing for hot or cold water.



GARLOCK'S specially designed Lattice-Braiding machines.

The Greatest Improvement Ever Made in Braided Packings!

The strands of Garlock Lattice-Braid packings are braided *through* and *through* on specially designed braiding machines. Since all strands are strongly linked together into a single unit, they are firmly held together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

This exclusive lattice braiding also provides unusual flexibility and semi-automatic pressure action which keeps the packing properly adjusted in the stuffing box. Longer service with less attention.

Garlock Lattice-Braid is manufactured from flax, cotton, asbestos, wire-inserted asbestos and "Teflon"—for various types of service. Furnished in ring, coil or on reels.

Write today for the new Lattice-Braid Folder.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
Tulsa, Okla. ...ston, Tex.
Los Angeles, Calif.

GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS

A NEW PICTURE OF SOUTHWESTERN

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REFINERY ENGINEERING *Company*

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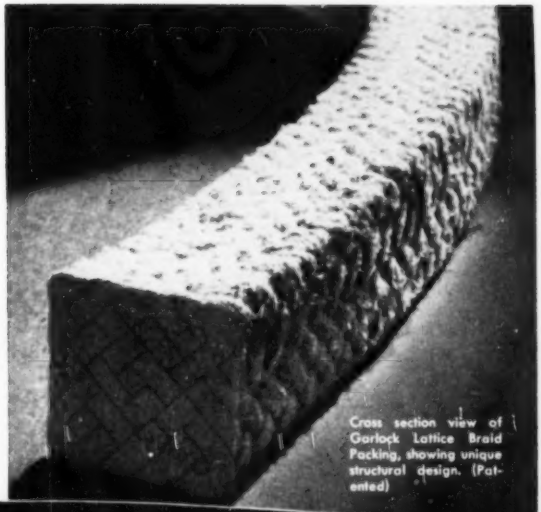
For Long

Trouble-Free Service

USE



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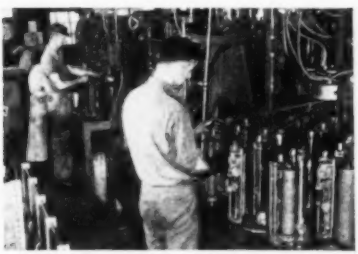

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THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
Tulsa, Okla. ston, Tex.
Los Angeles, Calif.

GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS

Fact: Average life-span in the U. S. A. is 67.6 years. The estimated average expectancy for the rest of the world is 44 years. The Bureau of Labor Statistics estimates U. S. life expectancy at 74 by 1975.

Question: Who worked out the plan under which this was achieved?

Answer: No one. It is the result of a process, not a plan. It came about largely through the American process of vigorous competition to provide life-saving new medicines, proficient doctors, modern hospitals, better shelter, abundant food supplies and machines that reduce work-effort. The average man-hour of work in 1951 produced 3½ times as much goods as the average man-hour in 1900. Hence, the same process is responsible for more leisure to enjoy longer life. Competition compels wider distribution, increasing productivity and better products, thereby improving and extending our individual lives.

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THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER OF PEOPLE

DU PONT REG. U.S. PAT. OFF.

PETROLEUM CHEMICALS DIVISION

NEWS

DU PONT REG. U.S. PAT. OFF.

August ★ One of a Series of Interest to the Petroleum Industry ★ 1952

Du Pont Wins Top Industrial Safety Award for 10th Consecutive Year

The "Award of Honor," the National Safety Council's highest industrial award, has been presented to Du Pont for 1951. This is the 10th consecutive year that the award has been won by the Du Pont Company. And Du Pont is the only company in the United States that has received the award 10 years in a row.

Last year was the safest in the company's history with a frequency rate for time-losing injuries per million man-hours worked of only 0.67. This represents an improvement of about 7% over 1950, Du Pont's previous best year. In achieving this outstanding safety record, 56 Du Pont plants had a perfect score—operated throughout 1951 without a single time-losing accident.

Du Pont Historical Highlights

The first salesman to go on the road to meet Du Pont customers was Charles L. Patterson. He started in 1802. Prior to Patterson, powder was consigned to agents who did the direct selling.

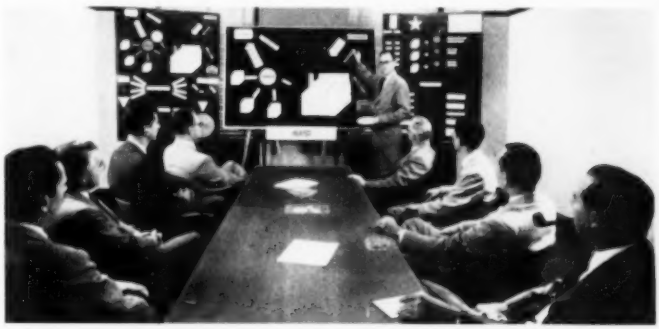
Today, 1600 Du Pont salesmen sell products and services to some 75,000 concerns, making over 1,000,000 calls a year. These range from one-man businesses at remote crossroads to the country's largest corporations.

The productive pace of the company's 72 plants from coast to coast is keyed directly to the orders these salesmen write in the highly competitive markets in which they sell.

HOBSO?...

A new way of explaining the American business system to your employees... available to all oil companies

"How Our Business System Operates" is the full title of an interesting, effective employee relations presentation available through Du Pont. Its main objective is to give employees a better understanding of the beneficial functions of capital and management in our competitive economic system. While this sounds like a complicated task, *Hobso* makes it easy.



THE CONFERENCE TECHNIQUE adds to the effectiveness of Hobso through group participation. With less than 20 employees in each group, the leader has ample opportunity to stimulate group discussion and to answer questions.

The presentation is built around 4 displays. Each highlights an important phase of our economic life. The first shows graphically the structural organization of modern companies in relation to our business system as a whole.

CAPITAL AND DIVIDENDS

It illustrates, for example, the influence of customer demand and buying power on such factors as wages and production volume. It also shows how the American people's savings become the source of capital for the research and product developments that create jobs. And the importance of dividends in encouraging more capital investment is emphasized, too.

Another display points up the problems of management in meeting the competitive pressure of our free markets. A third gives a clear, concise picture of how our already high standard of living is constantly being raised through greater production . . . and how our tremendous investment in scientific investigation and technical improvements have made this possible.

Then, in easy-to-understand language, *Hobso* shows why our constitutional freedoms must be preserved if we are to continue to enjoy the economic freedoms which enable us to live better than any other people in the world.

PERSONALIZED PROGRAM

One of the unique features of *Hobso* is that the program can be applied to the operations of any individual company. One large oil company, for example, has added to the basic *Hobso* program a display illustrating its own position in our business system. This program has been used successfully for over a year under the leadership of the company's own representatives trained by Du Pont.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

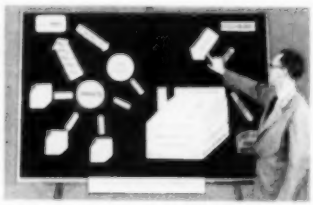
CONTINUED *Hobso...*

GROUP PARTICIPATION

The presentation is completed in three meetings. Each lasts about an hour and a half. It is important to note that the presentation is not given as a lecture—employees are brought into the discussions and thus are permitted to play a managerial part.

For maximum effectiveness, 15 to 20 employees are the ideal number for each conference group. The discussions should be led by a speaker with a sound background in economics and a thorough indoctrination in the technique of presenting *Hobso*.

The displays consist of a progression of related cards representing the important factors in our economic system. These can be readily fastened to the large flannel board. And they are as simple to set up as a child's building blocks.



EACH DISPLAY is built progressively on the flannel board. The velvet-like backing on each of the cards sticks readily to the flannel surface when pressed with the hand.

ORIGINATED BY DU PONT

The *Hobso* presentation was originated and developed by Du Pont. And during the past two years it has been shown to over 70,000 Du Pont employees.

In addition, it has been shown to over 500,000 employees of 325 other companies throughout the country. Du Pont makes the presentation available through the National Association of Manufacturers and to oil companies in particular through the Du Pont Petroleum Chemicals Division.

A pocket-size booklet summarizing the presentation is available to be handed out to each employee at the end of the three *Hobso* meetings. And for continuing employee economic education, a *Hobso* No. 2 presentation has been worked out by Du Pont and is also ready for use. This traces basic changes in our business system during the past ten years.

A Psychiatrist Speaks on Safety

GERALD GORDON, M.D.

Speaking on the "Psychiatric Aspects of Safety," Dr. Gerald Gordon of the Du Pont Medical Division has been making a series of unusual talks that are of particular interest to the petroleum industry.

The theme of these talks is based on the fact that the majority of accidents are not accidental but have the appearance of self-inflicted injuries. Individuals who repeatedly injure themselves also show the same inadequacy in meeting their problems generally. In other words, accident repeaters suffer from a common but little recognized form of mental sickness.

During a recent tour of the Pacific Coast area, Dr. Gordon spoke before a number of oil company groups which included marketing, transportation and executive personnel, as well as refinery representatives.

Dr. Gordon was graduated from the University of Alabama and the School of Medicine at the University of Louisville.

In 1946 he joined the Du Pont Medical Division as staff psychiatrist. Previous to this, Dr. Gordon had a private practice in Los Angeles from 1938 to 1941. During World War II he was with the British Medical Service and later joined the U. S. Army Medical Corps, studying and working in psychiatric hospitals and schools.

Two Du Pont Movies Shown to Over 90,000 By Oil Companies

Two Du Pont movies produced for the exclusive use of the oil industry within the past 2 years have been shown to audiences estimated to be well over 90,000.

The movie, "What Makes a Gasoline Good," has been shown to an audience of over 51,000 with prints loaned to oil companies by the Du Pont district offices. In addition, it was shown on two television broadcasts with an estimated total audience of 15,000. These figures, moreover, do not include the audiences for 77 prints of the movie which were purchased by various oil companies for their own showings.

Through 423 recorded loans, "Pipeline on Wheels" has been shown to an estimated audience of 45,000. But the total audience is probably far greater because 52 prints of this film, too, have been purchased by oil companies for their own use.

LITERATURE AVAILABLE

Here is a partial listing of the bulletins, reports, booklets and aids available to you through your Du Pont Petroleum Chemicals Division district office:

Safety for the Small Refinery — A 42-page book on how to set up an effective small refinery safety program. Serial A-2848

Tank Talk — A 52-page, easy-to-understand safety booklet for tank-cleaning crews. Serial A-1134

Stability of Present-Day Gasolines — A 12-page paper on the value of storage tests—as compared with induction period—for determining stability of modern gasolines. Serial A-3199

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Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division ● Wilmington 98, Delaware

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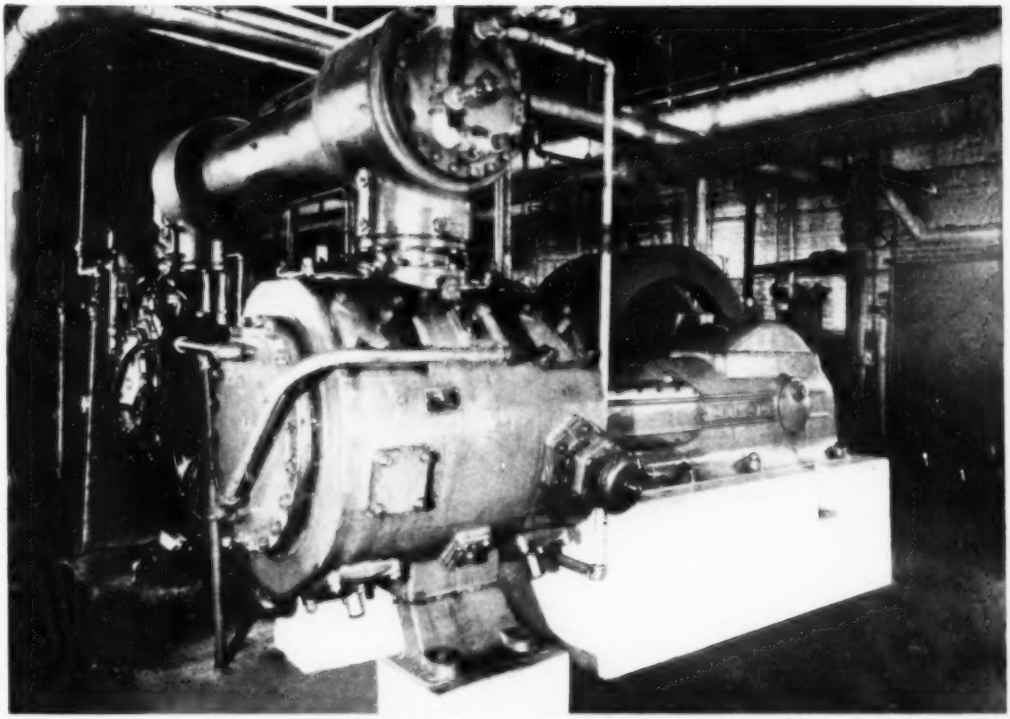


ONE OF FOUR WORTHINGTON GAS COMPRESSORS in the gas distribution system of a large Eastern gas company. Compressor is positive displacement reciprocating type with capacity of 125,000 standard cu ft of manufactured gas per hour. Maximum discharge pressure is 100 psi. Volume is controlled by Worthington's automatic variable capacity control.

When a large Eastern gas company needed another gas compressor . . .

. . . There was no question about which make should be selected!

The gas compressor in the picture had been working so well since 1949 that Worthington was the logical choice for the *next* new compressor to handle expanded capacity.

These Worthington features constantly increase the number of such choices:

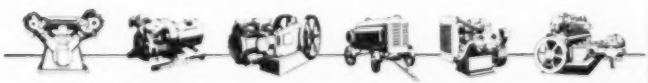
Accurate control of volume that is always assured with Worthington's automatic variable capacity control—acknowledged most accurate, flexible and simple control obtainable.

Worthington's exclusive Feather Valve*—simplest, lightest, most efficient ever made—eliminates valve problems. And Worthington's high-efficiency intercooler needs less water, less power.

Somewhere in the broad line of Worthington compressors, for air, gas or other "compressables", there is the one right type and size for your job. *Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.*

*Reg. U. S. Pat. Off.

K-2-15



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WORTHINGTON

Compressors

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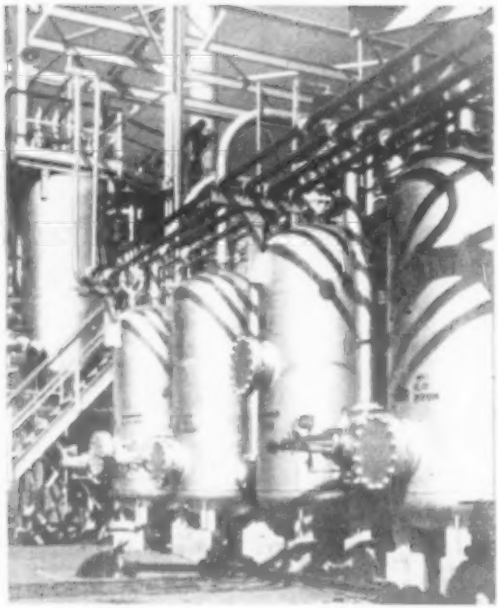

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Want to be certain of quality and uniformity in the chemicals you use for processing operations? Make sure you get them from SOLVAY—America's leading producer of alkalies and associated chemicals! You can also depend on SOLVAY for *service*—for helpful *sales* service from thirteen sales offices and a nationwide chain of distributors; for *delivery service* from centrally-located plants and over 200 coast-to-coast stock points; and for an exclusive Technical Service for the petroleum industry.

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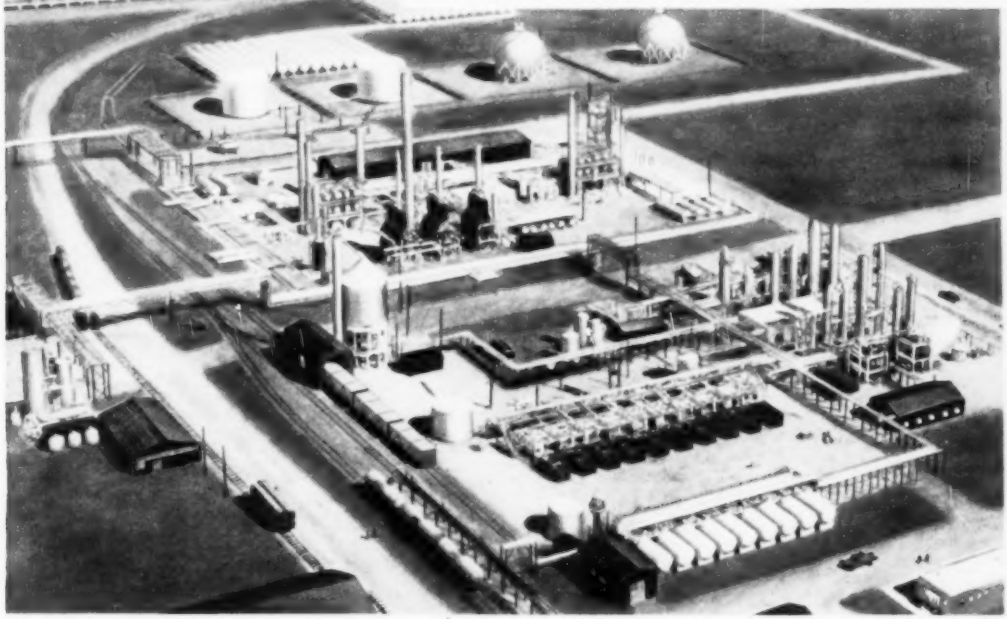

Mathieson Chemical Corporation Plant
Doe Run, Kentucky

From Gabe, Kentucky, liquid hydrocarbons extracted from natural gas are piped to Doe Run. Here, at the rate of 450,000 gallons per day, they are converted into domestic bottled gas, natural gasoline, and "permanent" anti-freeze, as well as intermediates for the manufacture of plastics and synthetic fibres.

STONE & WEBSTER ENGINEERING CORPORATION
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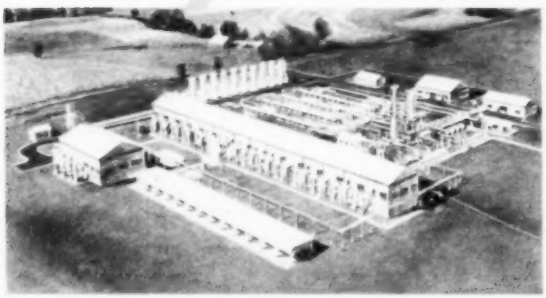
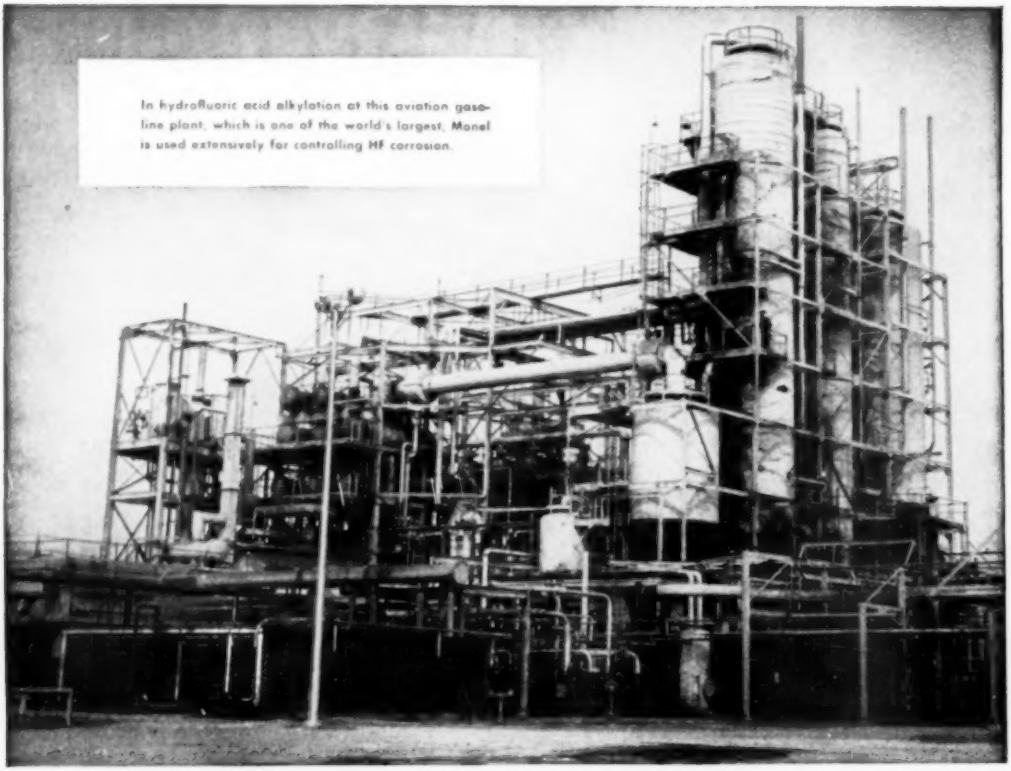
AFFILIATED WITH E. B. BADGER & SONS (GREAT BRITAIN) LTD.



Hydrocarbon Extraction Plant
Tennessee Gas Transmission Company, Gabe, Kentucky



In hydrofluoric acid alkylation at this aviation gasoline plant, which is one of the world's largest, Monel is used extensively for controlling HF corrosion.

MONEL *for handling* HF *and* FLUORINE

Experience has proved that for maximum safety, and corrosion resistance, Monel® is among the most satisfactory materials of construction for handling fluorine and its more active compounds.

Monel is highly resistant to ignition by fluorine. It has been successfully used to handle fluorine at pressures up to 400 pounds per square inch, and has shown economical corrosion resistance at temperatures up to about 900°F.

Not only is Monel highly resistant to attack by fluorine, it also shows good corrosion resistance to anhydrous hydrogen fluoride and to steam-HF mixtures, even at temperatures as high as 1100°F. A proven practical application of these facts has been the established use of Monel in hydrofluoric acid alkylation units in petroleum plants.

In addition to excellent chemical characteristics are Monel's well-known physical properties... high strength ...easy fabrication and welding.

But remember, Monel is on extended delivery now because so much is taken for defense. In order to improve your chances of getting delivery when you need it, it's wise to place your orders—with necessary NPA rating and complete end-use information—well in advance of your construction schedule. And, if you have a special metal problem, Inco's Technical Service Section will be glad to help you solve it. Write today giving full details.

EMBLEM OF SERVICE INCO TRADE MARK

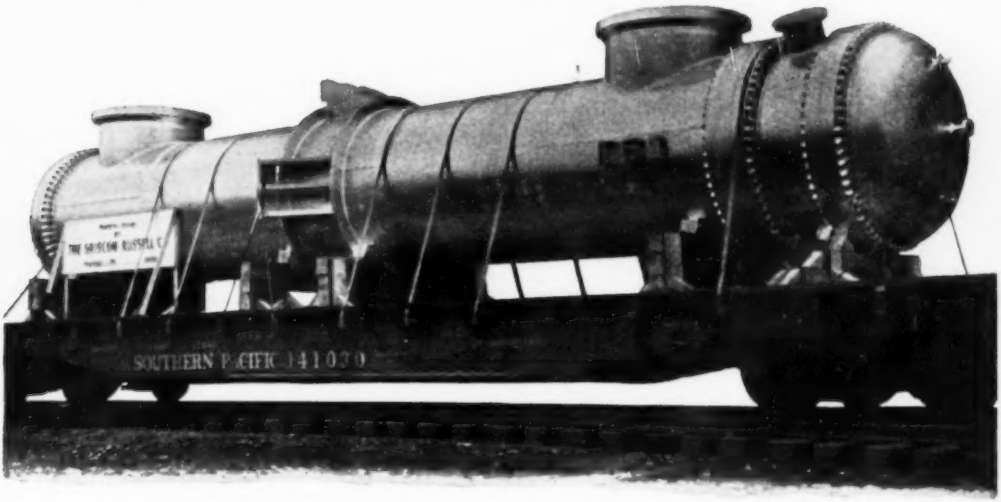
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

MONEL ...for minimum maintenance

No Limit!

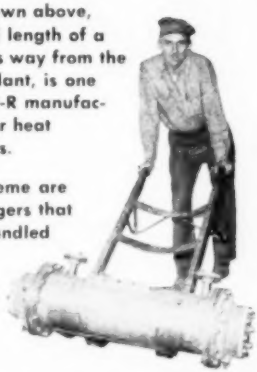
to type of

G-R Tubular Heat Exchangers



The huge unit shown above, occupying the full length of a 53-ft flat car on its way from the Griscom-Russell plant, is one example of the G-R manufacturing facilities for heat transfer apparatus.

At the other extreme are G-R Heat Exchangers that can be readily handled by one man.



Between the two extremes of the illustrated G-R Tubular Exchangers are the many types of G-R Heaters, Coolers, Condensers, Evaporators and Heat Exchangers, of which Griscom-Russell has built almost 200,000 to handle all types of liquids, gases and vapors for all industries.

Each G-R design is based on the 85-year specialized experience of the oldest and largest exclusive manufacturer of heat transfer apparatus. Each type has many distinctive features that assure superior effectiveness, economy and durability.

Write for 32-page bulletin describing G-R Tubular Heat Exchangers in detail.

THE GRISCOM-RUSSELL COMPANY
MASSILLON, OHIO

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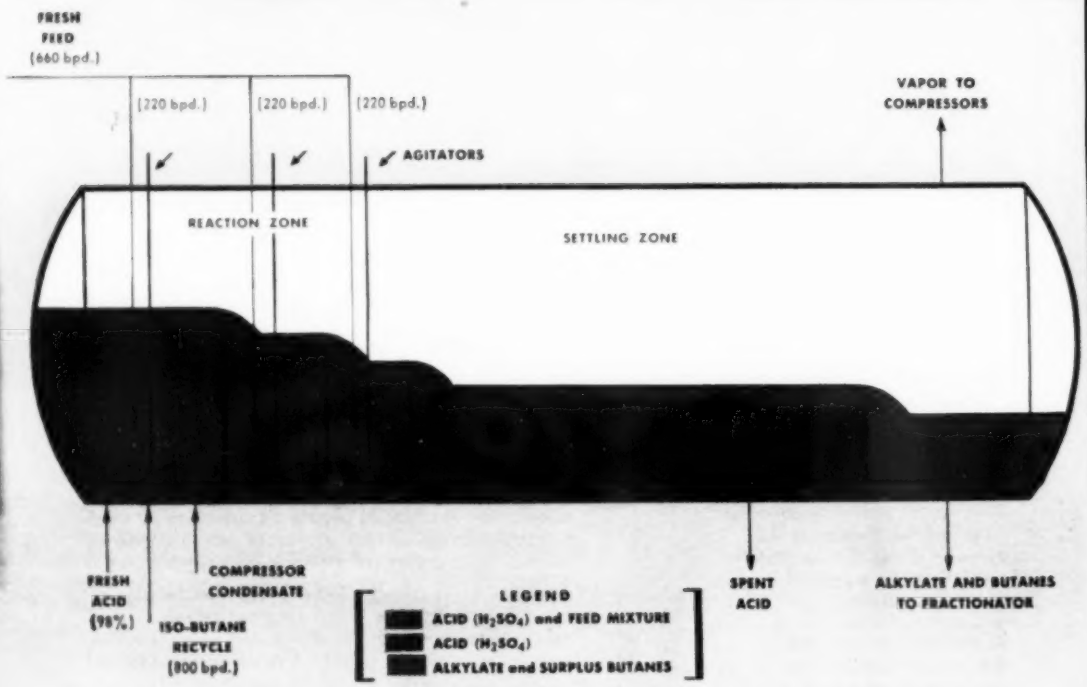
GRISCOM-RUSSELL
PIONEERS IN HEAT TRANSFER APPARATUS

This NEW Kellogg-cascade reactor initial cost



How New Reactor Maintains 9-to-1 Isobutane-Butylene Ratio

Assume, as a simplified case, that fresh feed is charged to the reactor shown here at 660 barrels per day. This feed, comprising a mixture of approximately 300 barrels of butylene and 360 barrels of isobutane, is divided into three equal 220 BPD portions, each of which is introduced into one of the three reaction sections.

To increase the amount of isobutane at the points of reaction, a recycle stream of isobutane from the unit's main fractionator is fed in at the bottom of the first section. This recycle must be at a rate of 800 BPD to provide the desired isobutane-butylene ratio.

Adding up the total amount of isobutane in the first reaction section, we find there are 920 barrels to 100 barrels of olefin. Since only about 110 barrels of the isobutane reacts with the total olefin present, about 810 barrels of excess isobutane are carried over into the second section where the cycle starts over again.

Thus, while the total amount of olefin charged each day to this reactor is 300 barrels and the total amount of isobutane is 1160 barrels (a ratio of about four-to-one), the actual ratio at all reaction points is better than *nine-to-one*.

designed brings lower to sulphuric acid Alkylation...

SULPHURIC ACID alkylation has long been recognized as a vital process in the production of high octane avgas and a valuable tool for upgrading a refinery's motor gasoline pool.

Now several Kellogg design innovations have been incorporated in this process which reduce the initial investment required, as well as the daily operating costs, for the production of a given quality and quantity of alkylate.

The most important improvements have been made in the reactor itself. With the new Kellogg cascade reactor, a highly desirable nine-to-one ratio of isobutane to butylene is maintained *in the reaction zones*—although the overall isobutane *feed* to the reactor is less than four-to-one. While increasing the yield and improving the quality of alkylate, this new design also materially reduces the number of pumps and permits use of smaller vessels than would otherwise be required to attain a high isobutane-butylene ratio.

In addition, the cascade flow of acid and fresh feed in successive stages radically improves the economics of acid consumption. When feeding 98% sulphuric acid to the new Kellogg units, the acid concentration can be maintained at an efficient average of 91.5% in all reaction zones, while the withdrawal concentration is kept at a low 88%.

Add to these advantages the low horsepower requirements of propeller-type agitation and the savings inherent in auto refrigeration cooling . . . and it is evident why many refiners are exploring the possibilities of modern sulphuric acid alkylation.

New Kellogg-Designed Units

UNITS OPERATING

In the Midwest—2500 BPD unit
In the Southwest—1000 BPD unit
On the Atlantic Seaboard—2200 BPD unit

UNITS UNDER CONSTRUCTION

In Texas—1200 BPD unit
In South America—1600 BPD unit

UNITS IN ENGINEERING

On the Atlantic Seaboard—3500 BPD unit
In Texas—1200 BPD unit

For further information, yield and inspection data, etc. write

THE M. W. KELLOGG COMPANY

(SUBSIDIARY OF PULLMAN INCORPORATED)

for fifty one years an integral part of petroleum refining progress!

KELLOGG

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LOWER MAINTENANCE COSTS

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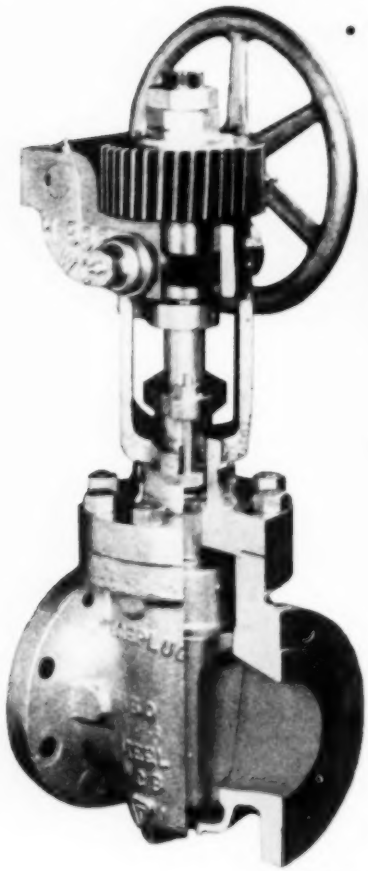

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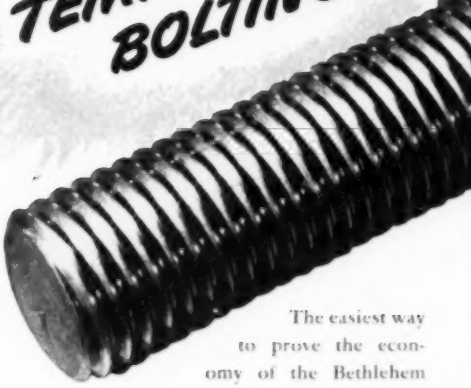
DRY PLUG ELIMINATES NEED FOR LUBRICATION

Use This Economical STUD for HIGH-TEMPERATURE BOLTING



The easiest way to prove the economy of the Bethlehem Continuous-Thread Stud is to give it a real trial, in bolting jobs involving high temperatures or high pressures, or both. You'll soon discover that this is a stud that can take it, and that down-time caused by stud breakage becomes virtually non-existent.

The Bethlehem Continuous-Thread Stud gives a good account of itself in difficult bolting applications because of its ability to minimize stress-concentrations. As the stud has no point of thread-runout, those stresses which do occur are well distributed over the entire length of the stud, and therefore cannot concentrate at any one point.

The Bethlehem Continuous-Thread Stud is made from carbon or alloy steels, and comes either plain or heat-treated. It is furnished in a wide range of diameters and in virtually any length, with many sizes carried in stock.

If you have any questions about the range of applications for which the Bethlehem Continuous-Thread Stud is best suited, put them up to the nearest Bethlehem office. Or write to us at Bethlehem, Pa.

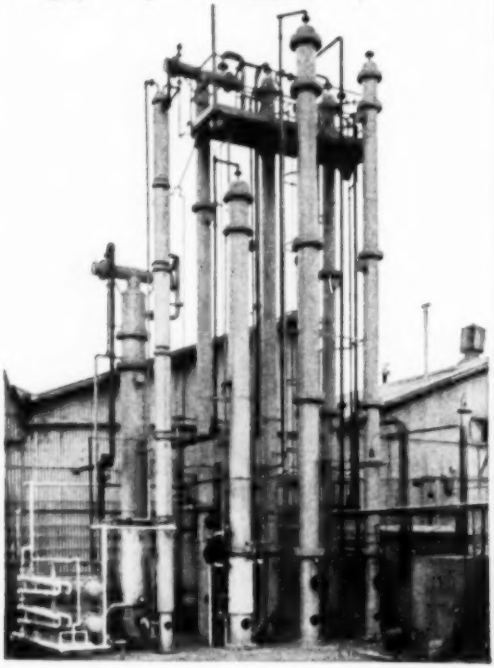
BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

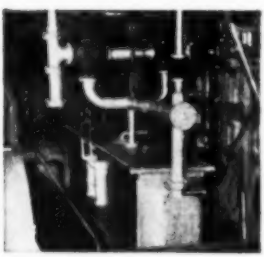
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Bethlehem supplies every type of Fastener

Oxygen plant **not** required!



Wulff Process Recovery and Purification section. In operation over 19 months, the plant has sold acetylene commercially for the past 10 months.



This fully automatic cracking furnace is the heart of the Wulff Process. In the past 10 months of commercial operation, this unit has required no maintenance—capacities and yields have remained the same.

Available from Fluor

The Wulff Process for the production of acetylene from hydrocarbons is available through The Fluor Corporation. With over 30 years' experience in the design, engineering, and construction of plants and facilities for the petroleum and chemical industries, Fluor possesses the background, the skilled personnel, and the know-how essential for the practical application of the Wulff Process into your particular program.

THE WULFF PROCESS

Acetylene from natural gas, ethane, propane, butane, or any LPG mixture

available through Fluor!

The manufacture of acetylene from hydrocarbons by thermal pyrolysis is now commercially feasible and economically attractive! This has been proved. In January, 1951, the Wulff Process Company placed in experimental operation a commercial-sized acetylene plant. The plant has been operating continuously for the last 19 months. During the last 10 months of this period, acetylene has been sold commercially. This same process may be applied to plants making as little as one ton per day of acetylene to as much as one hundred tons or more per day.

The Wulff Process Company plant has experienced continuous operation on a wide variety of hydrocarbon feed stocks. Methane and propane have been used commercially. Test operations with ethane, butane and various hydrocarbon mixtures have demonstrated that a single plant with modification only in operating conditions can be used for a number of feed stocks. The process can be operated to produce substantial yields of commercial grade ethylene simultaneously.

Regardless of whether your activities lie in the production of petrochemical feed stocks, the manufacture of end petrochemical products, or both, it will pay you to investigate this commercially proven process for the recovery of low-cost acetylene from hydrocarbons. Your nearest Fluor representative will be pleased to provide detailed information on specific requirements. Contact him today!

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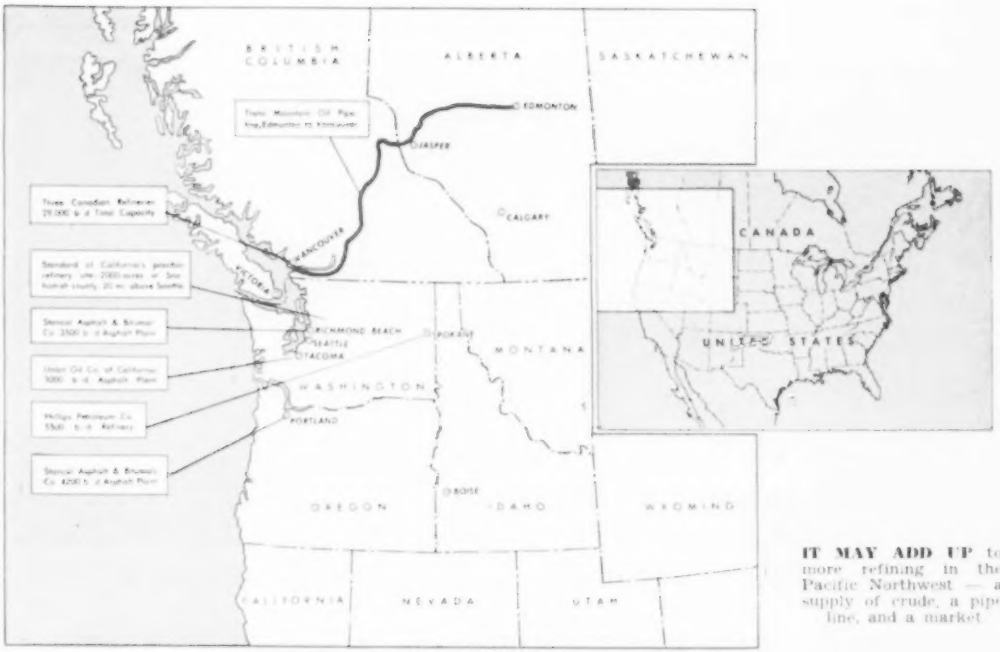


IT MAY ADD UP to more refining in the Pacific Northwest — a supply of crude, a pipe line, and a market

Refiners Look to Pacific Northwest

Will Alberta crude and pipe line to Vancouver open up a new center of refining activity?

By ***FRANK BREESE***
West Coast Editor

THE oil industry's long-range planners are occupied by the intriguing Riddle of the Pacific Northwest: "What should my company do about that region?" With the discovery of oil in western Canada in 1947 and construction of a pipe line which will carry some of that new crude to the Pacific Northwest border by 1954, interest in that area is keener than ever.

All basic segments of the oil industry are affected, but manufacturing is especially concerned because of the question of building refineries there. And just as big as the riddle of "What to do?" is the parallel one of "Who is going to do it?"

Two years ago the west coast majors seemed much more inclined to build refining capacity in the area than they do now. At that time, General Petroleum indicated it might put up a completely new plant there.

Just last month Standard Oil Co. of California announced the purchase of approximately 2000 acres of land in Snohomish County, Wash., 20 miles north of Seattle and with a partial frontage on Puget Sound. But at the same time the company announced that it "hasn't any plans of any kind now for the use of this tract. However, the way the Pacific Northwest is growing, both in population and industry, indicates to us that sooner or later it may be desirable to build a refinery there to take care of the expansion of our business. Frankly, we don't know whether this will be two years or 10 years, but we want to be prepared when the time comes."

None of the other five west coast majors* reports any solid plans, although most of them do admit to having the matter under constant study.

In fact, some of the companies seem to favor this approach: Buy the Canadian crude, ship it to their California refineries for processing, then ship the products back to the Pacific Northwest for distribution. As the market grows, they could expand existing refining capacity in California.

There is growing speculation on the West Coast, on the other hand, that if one of the local firms doesn't act, then some major company east of the Rockies or an independent group will soon move in.

Plans for at least one new independent refinery in Washington are already well advanced by a

*Richfield, Shell, The Texas Co., Tide Water Associated and Union Oil of California, in addition to General Petroleum and Standard of California.

FIRST COMPANY to announce refinery expansion in Pacific Northwest was Imperial, which will increase its 12,000 b/d plant at Ioco, B. C. to 22,500 b/d. (Aero Surveys Ltd. photo, courtesy Imperial Oil Ltd.)

group of financiers, PETROLEUM PROCESSING was told by a prominent Seattle business man. Details were withheld, however.

Popular guessing is that whoever builds, the plant will probably be located on Puget Sound, center of water transportation in the area.

Independent jobbers would like to see a refinery built, preferably by some group other than a major. They believe that would improve their own situation by reducing their present dependence on major suppliers. Some jobbers have been desperate for gasoline this year, due to the tight supplies.

Public officials are eager to see refining capacity established for two reasons: (1) as a defense measure it would lessen the area's dependence on tankers, and (2) as a new industry it would enrich the area's economy.

Broadly speaking, the Pacific Northwest encompasses British Columbia, Washington and Oregon along the coast, Idaho, western Montana and a slice of northwestern Wyoming. However, as a petroleum products market it is defined as British Columbia, Washington and Oregon, with Alaska thrown in.

Current consumption of petroleum products in the area is approximately 250,000 b/d, which has been supplied historically and almost entirely by California.

There are seven refineries in the area—three in British Columbia, three in Washington, and one in Oregon, listed in Table 1. Of the four U. S. plants, three are asphalt refineries.

That means that practically no gasoline, light or middle distillates are being manufactured in the U. S. Pacific Northwest. Only in British Columbia are these products being made in any appreciable volumes, and even that output is at present insufficient to meet the demands of the local market.

Table 1—Refineries in the Pacific Northwest

	Charge Cap., b/d
Imperial Oil Ltd., Ioco Refinery Vancouver, B. C.	12,000
Shell Oil Co. of Canada Ltd., Burnaby Refinery Vancouver, B. C.	7,000
Std. Oil Co. of British Col., Stanovan Refinery Vancouver, B. C.	10,000
Stancal Asphalt & Bitumals Co., Asphalt Plant Richmond Beach, Wash.	3,500
Union Oil Co. of Calif., Asphalt Plant Edmonds, Wash.	3,000
Phillips Petroleum Co. (shut down) Spokane, Wash.	5,500
Stancal Asphalt & Bitumals Co., Asphalt Plant Portland, Oregon	4,200
TOTAL Charge Capacity	45,200

Canadian Refinery Expanding

Refining capacity in Vancouver, though, is being increased as a result of the decision to push through the crude oil pipe line from Edmonton, Alberta, to Vancouver. Imperial Oil Ltd. will enlarge capacity of its Ioco refinery from 12,000 b/d to 22,500 b/d and recently awarded the contract for the major portion of the $13,500,000 construction program to Canadian Bechtel, Ltd. New equipment will replace most of the existing process units. It will include a Fluid catalytic cracking unit with 7,500 b/d capacity. Completion is scheduled for next year or early 1954 to coincide with the opening of the pipe line.

That will lift Vancouver's throughput to 39,500 b/d, nearly enough to meet British Columbia's needs.

Laying of the 695-mile, 24-inch Edmonton-to-Vancouver pipe line began in June, and is expected to be half-finished by October, when weather closes down work for the winter. The venture is backed by the Trans-Mountain Oil Pipe Line Co. Three West Coast majors are participating

TERMINUS OF PIPE LINE to carry crude from Edmonton to Vancouver will be in vicinity of area above, where Standard of British Columbia has a 10,000 b/d refinery near Vancouver. (Cal Pictures photo)

Standard of California (through its subsidiary, Standard of British Columbia), Union Oil and Richfield. Both Standard of California and Union Oil have engaged in large-scale exploration in Canada, though production is moderate. Richfield has recently entered that field.

Others participating in the pipe line are Canadian Gulf Oil, Imperial Oil, Shell Oil of Canada, Bechtel and a group of independent oil producers of Alberta. Between them, they have acquired $12,500,000 worth of common stock. The project will cost $82 million.

Initial capacity will be 75,000 b/d. By adding pump stations, ultimate capacity can be stepped up to 200,000 b/d, which represents about 10% of the energy consumed on the Pacific coast.

The 200,000 b/d capacity may seem exceptionally large because Alberta doesn't have that much surplus yet, and B. C. lacks the refining capacity. But, as Imperial Oil Executive Vice President John R. White remarked, "For growing youngsters, it pays to buy clothes a size or so too large."

With Vancouver's demand running around 40,000 b/d, there will be a prospective surplus of 35,000 b/d if the pipe line flows 75,000 b/d of Alberta crude. Potential surplus will be 160,000 b/d.

That means between 35,000 b/d and 160,000 b/d of Canadian crude may be stock-piled at the American boundary—waiting to cross into Washington or go some place else.

With that crude available, why not just build a refinery?

Mr. White declared that both the Pacific Northwest and Minneapolis areas could benefit from refineries. "Not only does a refinery usually bring savings in fuel cost, but it helps to stimulate other industries of a chemical nature," he said.

A refinery has to be justified economically, and so far the majors, individually, seem to question whether one is.

On the American side, the 250,000 b/d market is split up among the seven majors and a few Independents. Standard of California, with about 25% of the market, is probably the only company that could justify a large refinery.

Expansion May Be in California

While a refinery of 10,000 b/d to 25,000 b/d might be adequate for a company, the key California refineries now have a throughput capacity of 50,000 b/d to 100,000 b/d and over. The companies don't dislike small refineries, but the trend has been toward the more efficient and flexible large-capacity plants.

Reticence of the majors to announce refinery plans has been interpreted that the individual companies believe they can accommodate their share of anticipated Northwest market growth within the expansion of existing California facilities. A company with 10% of the present market on the U. S. side, or 20,000 b/d, would expect to add another 10,000 b/d to its market by 1960. Enough for an average size refinery, but not a large one.

A large refinery might be economically feasible as a joint venture. But it's doubtful that the Justice Department Anti-Trust Division would tolerate such an arrangement, a major company executive declared.

A new refinery may involve a capital outlay of from $25 million to $100 million. A company would have to be assured of a foolproof pay-out before authorizing that kind of expenditure.

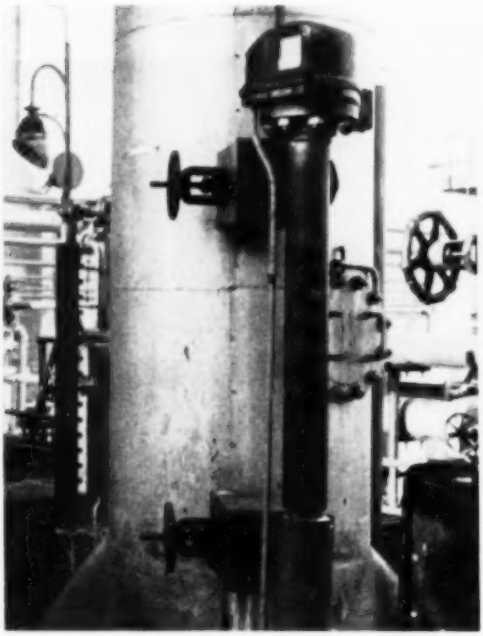
The manufacturing vice president of a West Coast major whose share is about 20,000 b/d told PETROLEUM PROCESSING it would be cheaper for him to ship available Alberta crude from Vancouver to California, process it, and re-ship the product to Seattle, than to build a refinery in Seattle.

So, the determining factor is economics. As long as the crude is available, the question of whether it should be refined and marketed in the Pacific Northwest or shipped to California, processed and tankered back for distribution has this answer:

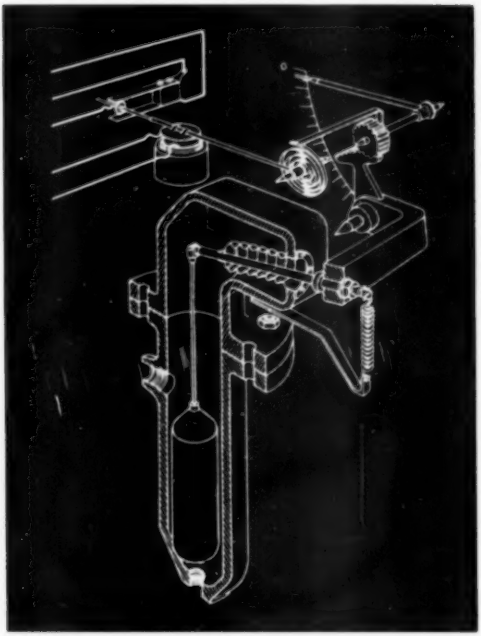
Which is cheaper—building a new refinery or utilizing cheap water transportation?

So far, tanker operating costs work in favor of that practice. But when the crude is actually available, the position may be different.

To illustrate how divided strategists are, top brass of one major can't agree on procedure. One faction opposes construction of a refinery. Yet one of the firm's key economists stated, "Whether we build it or someone else does, there will be a large refinery on Puget Sound in the foreseeable future."



LIQUID LEVEL TRANSMITTER as installed on a processing tower



HOW TRANSMITTER WORKS in the case of liquid level measurement and control

Electronics Control Refining Unit

By LEO WALTER
Consulting Engineer,
Cheltenham, England

A NEW sulfur dioxide extraction unit for producing premium grade kerosene, put on stream late in 1951 at the Llandarcy, South Wales, refinery of National Oil Refineries Ltd., is believed to be the first petroleum processing unit in the world under complete electronic control.

The plant, a part of Anglo-Iranian Oil Co.'s development program for the United Kingdom, was designed to produce 330 tons a day (about 2300 b/d) and is actually operating at a rate of 500 tons daily (about 3500 b/d).

Process instrumentation comprises 24 electronic controllers, 17 being concerned with liquid level, 4 with flow, and 3 with pressure. Designed and made by Eversheds & Vignoles Ltd. of London, the process controllers are used to regulate standard diaphragm motor-operated control valves, using air as the motive power. Connections between primary measuring elements, control panel, and valves is by multiple core telephone cable using electric signals in the form of small, continuous direct current. The equipment has been certified as intrinsically safe and it is independent, within wide limits, of variations in the voltage and frequency of power supply.

The advantage of electronic, as compared to pneumatic, operation lies in the fact that the response to control is virtually instantaneous, irrespective of the distance between plant and control room. Time lags due to the compressibility of air, inherent in any pneumatic transmission, are eliminated. Deviations from the required flow, pressure, or level values are detected and corrected instantaneously.

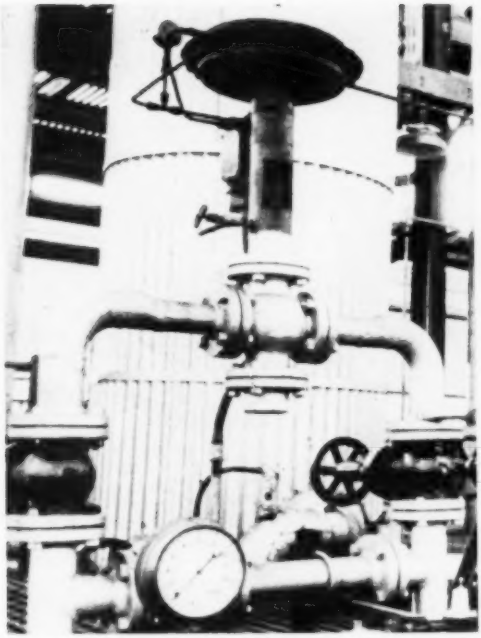
Typical operation with liquid level is illustrated in the two sketches and photographs. The electronically operated level transmitter was designed to detect liquid level, or the interface between two liquids, in a pressure vessel, and to transmit an electric signal proportional to this measurement.

The body of the transmitter is fabricated from steel tubing, designed for a working pressure of 750 psi. maximum. It is arranged for side and bottom connections, and the transmitting head together with the local indicator contained in it may be located in any of eight angular positions with respect to the side entry. The two pressure connections are screwed 2 in. API.

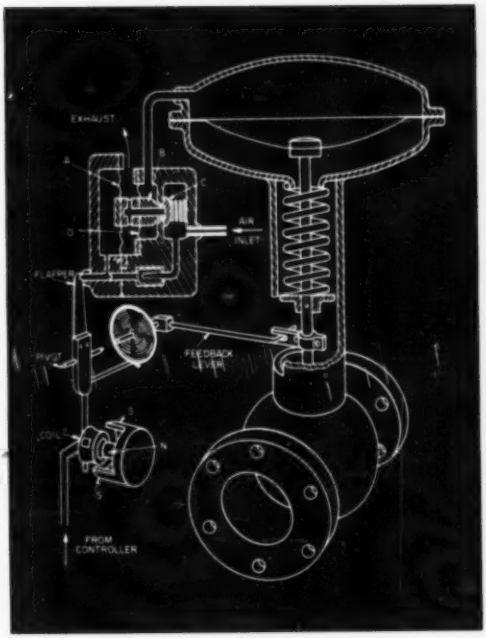
Movement of the displacer is brought out through a double-walled, flexible, stainless steel bellows. All adjustments, springs, and bearings are outside the pressure vessel.

The displacer is cylindrical in shape and is fabricated from stainless steel. It is attached at its upper end to a pivoted beam. The other end of the beam carries a toothed quadrant engaging a gear wheel, as indicated in the diagram. One end of this shaft carries a pointer moving over a scale calibrated in terms of level; the other end is attached to a pivoted arm carrying a moving coil which works in the field of a permanent magnet. The quadrant arm is connected to a tension spring acting in opposition to the weight of the displacer.

Any change of level over the displacer will vary the displacement force, and hence the weight supported by the tension spring. To re-



VALVE POSITIONER as installed with the electrical relays connected



HOW VALVE POSITIONER WORKS when it is tied in with the level transmitter for flow control

store balance, the length of the spring must change, moving the beam and the toothed quadrant. This, in turn, operates the shaft to move the pointer over its scale and also wind up the instrument type spring, the angular movement being proportional to the change in level over the displacer.

The bearings of the beam are carried on a stirrup which allows them to be placed in line with the flexible metal bellows mounted inside the pressure chamber. One end of the bellows is connected by a welded joint to the displacer end of the beam, while the other end—which is concentric with the beam—is connected by a similar joint to the case of the pressure vessel. End pressure on the bellows is thus taken up as reaction in the bearings of the beam. The effect of radial pressure is nullified by reason of the relative position of the bearing axis and the bellows.

The beam carrying the moving coil terminates in a moving contact which operates between two fixed contacts. This moving contact is connected through a suitable circuit to the grid of an electronic tube, and the two fixed contacts supply positive and negative bias potentials. The anode circuit of the tube is completed through the moving coil in series with remote milliammeter indicators or recorders.

Movement of the displacer will vary the torque of the instrument type spring, whose outer end is connected to the moving coil beam. This torque is opposed by that of the moving coil in the field of a permanent magnet.

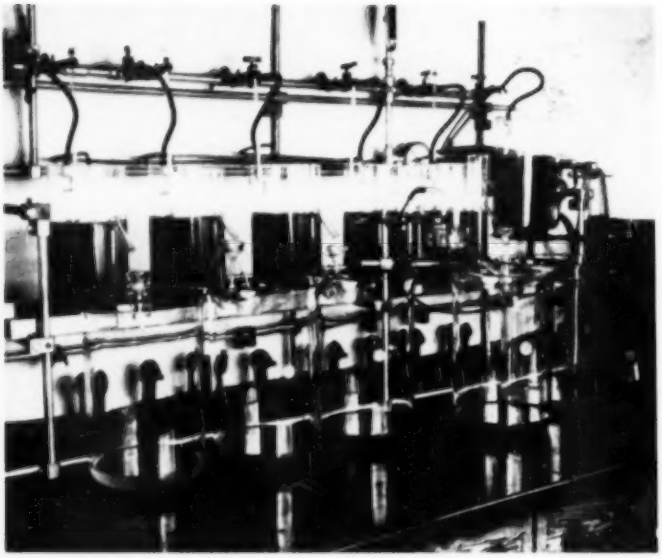
The regulating unit in the majority of cases takes the form of a diaphragm motor operated control valve using air pressure as the motive power. A conversion unit is necessary to translate the electrical output of the controller into terms of valve position. This is accomplished by the electro-pneumatic relay mounted on the control valve head, as shown in the drawing.

In the relay is a pivoted beam, at one end of which is a coil operating in the field of a permanent magnet and through which the signal from the process controller passes. At the other end of the beam is a flapper operating in conjunction with the nozzle of a low-bleed type air relay, the output from which is fed to the diaphragm head of the valve under control.

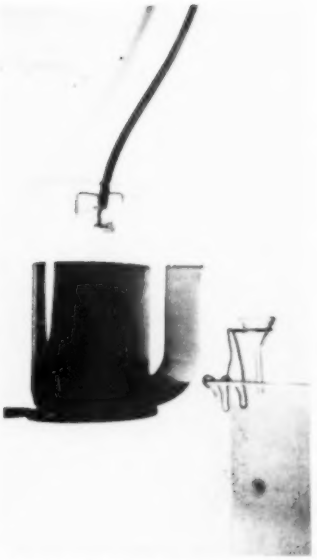
This beam is attached to the inner end of an instrument type spring which exerts a turning moment about its pivots, while the other end of the spring is connected to an adjustable feedback lever fitted to the valve stem. Movement of this lever therefore varies the torque exerted by the spring, which is so arranged as to oppose that generated by the coil. When the system is in balance, the spring torque is equal to that produced by the coil, which in turn is proportional to the controller output. Therefore, any change in this output will unbalance the beam, causing a movement of the flapper with respect to the air relay nozzle.

Air flow through the nozzle will then vary and hence the pressure on the primary diaphragm *A*, which will move, carrying with it the hollow plunger *B* operating in conjunction with spring-loaded valve *C*. Increase of pressure on *A* will connect the diaphragm head of the controlled valve to the air pressure inlet. Decrease in pressure will connect it to the atmosphere. The action continues until the force on the secondary diaphragm *D* equals that on *A*, when a state of balance is restored at a new output pressure, and both *B* and *C* are closed.

Variations of pressure on the diaphragm will move the valve stem, carrying with it the feedback lever, and hence moving the outer end of the instrument type spring. This movement is in such a direction as to correct the unbalance between the spring and the moving coil torques, and a state of balance is restored with the valve stem in a new position. As movement of the valve stem bears a linear relationship to the spring torque operating on the beam, it will be seen that the valve position is directly proportional to the input signal, irrespective of air pressure and friction loading on the valve.



CONTINUOUS, BENCH-SCALE TREATMENT of activated sludge is carried out in this series of units



AERATOR-SETTLER UNIT shown in close-up detail

BENCH-SCALE METHOD FOR

Treating Waste by Activated Sludge

Continuous, rather than, batch technique shows process has advantages in cutting refinery effluent contamination

By ***RICHARD H. COE***
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EFFECTIVE treatment of petroleum refinery waste water should result in a significant reduction in the concentration of whatever organic contaminants may be present.

Possible contaminants include hydrocarbons and organic compounds containing nitrogen, oxygen, or sulfur. Some of these substances would be toxic to marine life in the stream receiving the waste water because they are toxic *per se*, and others would be toxic to the extent that they remove oxygen from the receiving body of water, causing asphyxiation of oxygen-breathing organisms. Refinery waste water also usually has undesirable characteristics of odor and color which should be improved for aesthetic reasons.

Among the methods for purification of water containing organic wastes, biological oxidation with activated sludge is known to effect a marked reduction in the concentration of pollutants responsible for either chemical or biochemical oxygen demand. Although no single description applies to all types of biological oxidation with activated sludge, a few generalizations afford a partial description of what treatment with activated sludge involves.

Activated-sludge treatment consists of air blowing the waste water undergoing treatment, in the presence of a gelatinous floc of coagulated colloidal material, bacteria, and protozoa. The surface of this zoogloeal mass, called activated sludge, sorbs pollutants and the aerobic microorganisms which reside in the floc and on its surface consume the sorbed material. The floc, which is kept in suspension either mechanically or by air-blowing, thus acts very much like a continuously renewed chemical floc with a large and strongly sorbing surface area. Some normal chemical oxidation can occur simultaneously in the liquid phase without benefit from the floc.

Both the activated-sludge process and the trickling-filter process are widely used for biological treatment of domestic sewage. It is generally considered that the activated-sludge process requires more careful control, and is more susceptible to upset from fluctuations in the composition of the waste water charged, than is a trickling filter. On the other hand, the activated-sludge process may offer advantages of lower initial cost and smaller space requirement. The trickling filter process has been applied successfully on an experimental scale to a petroleum refinery effluent, the removal of "oil" and B.O.D. (Biochemical Oxygen Demand) being on the order of 80-85%; however, no reported use of the activated-sludge process for this purpose has come to our attention.

This article describes an improved apparatus and technique for bench-scale study of the activated-sludge process and the successful applica-

tion of this equipment in the laboratory treatment of a typical refinery effluent. A more detailed description of this work is given elsewhere[2].

Description and Operation of Treater

Bench-scale study of activated-sludge treatment has usually been made with an apparatus requiring batchwise introduction of feed and batchwise removal of product. It is recognized, however, that the abrupt increase in the concentration of contaminants whenever a fresh batch of feed is introduced may be deleterious to the micro-organisms, and the treatment obtained therefore may not be completely representative of the treatment obtaind in a continuously operated plant-scale treater. Furthermore, a batchwise treater may actually require more frequent attention than a continuous treater since the supply of pollutants on which the floc thrives must be manually maintained at close to an optimum level.

In view of these drawbacks to batchwise treatment, a set of six continuous, bench-scale treaters was devised. Each unit of the set consisted of (1) a feed tank, (2) a peristaltic pump for delivering feed to the aerator, (3) an aerator and attached settler, and (4) a product receiver. Views of the apparatus are shown in the photographs. The size of the apparatus and the operating conditions were as follows: volume of aerator and settler, 1500 ml.; feed rate, 1.4-6.3 ml./min.; aeration period, 4-18 hr.; air rate, 0.1 cu.ft./min. The treaters were operated at room temperature, which was usually 70-75° F.

The pump was a "Sigmamotor" pump, Model T-6, made by E&M Enterprises, Inc., of Middleport, N. Y. Six rubber tubes, each handling a feed stream to a unit, were held between a fixed plate and a series of ten fingers. These fingers squeezed the rubber tubes against the backup plate in sequence to milk the fluid through them.

Feed was introduced at a predetermined rate into the aerator, and product was allowed to overflow from a spout on the side of the settler. The mixed-liquor in the aerator was agitated by air delivered through a bubbler of porous glass located on the bottom of the aerator. The suspended solids which settled in the settler were continuously reintroduced to the aerator by turbulence which normally extended into the lower third of the settler. Foaming in the aerator was controlled by the addition of Dow Corning "Antifoam A", as needed.

The feed tanks were usually refilled with fresh waste water every twenty-four hours. No special precautions were taken to prevent contact of the feed with air because it was observed that air oxidation of the pollutants on standing at room temperature was very slow. Before introduction to the aerator, each lot of feed was analyzed for oxygen consumed (permanganate method (O.C.), 5-day biochemical oxygen demand (B.O.D.), and phenols. Additional analyses were made on a retain sample of feed stored for one day at 40° F. Treated product collected during the first 18 hours after starting with a fresh feed was discarded, and analyses were made on the product collected 18 to 24 hours after starting with a fresh feed. On week ends, the products collected on Saturday and Sunday were discarded.

The most satisfactory procedure for developing the activated sludge for bench-scale treatment of refinery waste water involved air blowing of domestic sewage for development of sufficient suspended solids, followed by acclimatization of the micro-organisms to the industrial waste by gradually increasing the ratio of industrial waste water to domestic sewage in the feed. Approximately one month was generally required for acclimatization of the sludge to refinery effluent.

Development of activated sludge by air blowing of refinery waste water was a prolonged procedure since the rate of growth of the suspended solids was very slow. This procedure, nevertheless, might be practicable in a plant-scale treater. Upon air blowing a spot sample of total refinery effluent for a few weeks, a suspension slowly formed which had the appearance of coarsely shredded tissue paper or milkweed seed. After about one additional month of continuous air blowing and batchwise feeding, a dark brown, easily settleable floc was obtained.

The condition of the floc was determined mainly by (1) the Mohlman sludge volume index (S.V.I.), which is defined as the number of ml. occupied by one gram of suspended solids after settling of mixed-liquor for 30 min., and (2) the rate of increase in the amount of floc in the aerator. The "redox" potential of mixed-liquor from the aerator was determined, but not used as a criterion of floc condition. A dark brown, earthy color of the floc served as a crude indication that the floc was healthy.

An S.V.I. of 50 to 125 ml./gram was usual, and treatment with a floc having a settleability in this range resulted in no difficulties in de-entrainment of the floc. An S.V.I. greater than 125 ml./gram was considered unsatisfactory, and values greater than 125 were observed during periods characterized by overloading of the treater and/or low pH of the feed. A sludge with poor settleability did not necessarily result in reduced effectiveness of treatment, but separation of floc from the treated product caused difficulties in operation.

The rate of growth of a floc fed with refinery waste water was about four percentile per day, or about 200 ppm. per day in a system with 5000 ppm suspended solids. This percentile increase is about one-twelfth that observed in some systems operating with domestic sewage. This slow rate of multiplication necessitated the extended period for development of floc during startup of a unit.

Three qualitative observations were made concerning the concentration of suspended solids in mixed liquor: (1) the rate of growth increased with an increase in loading; (2) suspended solids disappeared from systems which were underloaded, appearing as a colloidal dispersion in the product water; and (3) it was possible for a system to operate satisfactorily without sludge removal and yet with little increase in the amount of floc in the aerator, the rates of growth and deterioration in a properly loaded system being about the same and small.

The potential, called the "redox"

Meet the Author

Richard H. Coe, technologist at the Wilmington, Calif., refinery of Shell Oil Co., has been associated with the company since 1948. He received B. A. and M. A. degrees from Wesleyan University in 1941 and 1942. In 1947 he received his Ph. D. from Stanford University, doing research in polarography.

In 1941 and 1942, he worked on projects sponsored by the Connecticut State Water Commission, and in 1944 he was affiliated with an Office of Scientific Research and Development project at Stanford in the field of colloid chemistry. Coe then spent the following year doing analytical research at the California Research Corp. In the years before joining Shell, Dr. Coe taught chemistry at Wesleyan University.

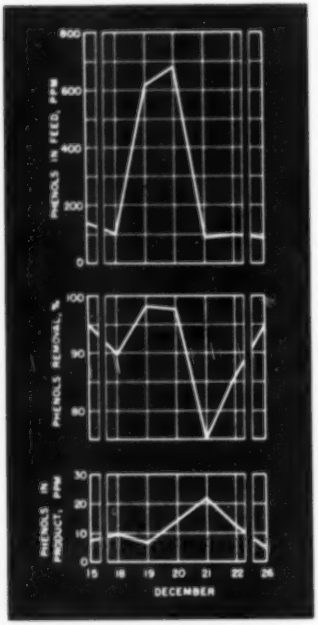

FIG. 1—Effect of shock overloading with phenols

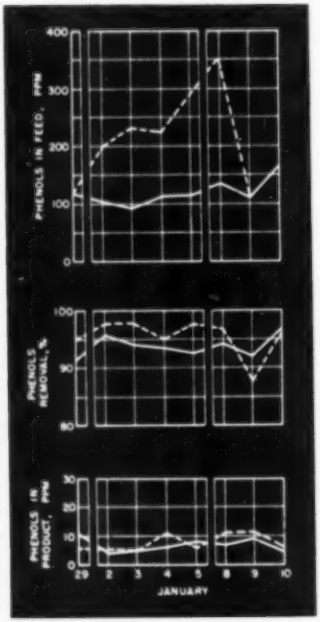

FIG. 2—Effect of slow increase in concentration of phenols. Broken lines, System A; Solid lines, System B

potential, between a standard reference electrode and a platinum electrode which is immersed in either the feed, mixed-liquor, or product has been used for estimating the efficiency of biological treatment of domestic sewage[1,2]. It was observed, as expected, that the electrode potentials of mixed-liquor in the aerator and the treated product were normally more positive than the electrode potential of the feed.

It was not possible, however, to define some particular value of the electrode potential of the treated product as a criterion for determining the efficiency of treatment since the electrode potential of the treated product fluctuated over a very wide range regardless of the treatment obtained. However, periods during which the electrode potential of the mixed-liquor was more negative than that of the feed usually corresponded to periods of abnormal and presumably unsatisfactory conditions, and during these periods it was considered that the floc was deteriorating although treating efficiency was not always immediately impaired.

Effect of Feed Composition

The waste water used in this study came from several or all of the following principal types of petroleum refinery units: thermal cracking, catalytic cracking, naphthene and butane isomerization, alkylation, acid treating, rolutizer sweetening, benzene and toluene manufacture, alcohol and ketone manufacture, and cresylic acid manufacture. The waste water did not contain domestic sewage.

On the basis of data obtained from systems operating under optimum conditions, biological oxidation with activated sludge resulted in removal of 90-95% of the phenols, 90-95% of the B.O.D., and 73-77% of the O.C. from waste water at pH 8 with an average composition of 100 ppm phenols, 1100 ppm. B.O.D., and 500 ppm O.C. The treated water was normally light yellow or light orange and it had a slight musty odor which was not unpleasant. Some of the major factors related to the wastewater composition which can influence the effectiveness of treatment with a given set of conditions for treatment are concentration of pollutants, acidity or alkalinity, inorganic salts, and sulfide.

In order to obtain satisfactory indications of the effect of variations in composition in a period of a few weeks, no elaborate attempt was made to achieve a steady-state condition between the suspended microorganisms and their environment. The influence of unknown variations in the types of pollutants in the waste waters was largely overcome by feeding essentially the same waste water simultaneously to all of the six systems which were used. In general, only one condition in each system was changed at one time, and one system, the control, was maintained at optimum conditions. Experiments with a given system were run consecutively. Average results over the period of examining the influence of a given condition were considered to be valid indications of what might happen in a plant-scale treater.

Loading: a system was considered to be properly loaded when the most effective treatment was continuously obtained and optimum characteristics of the suspended solids were maintained. In general, these criteria were satisfied with nine to twelve hours of aeration in the presence of 4000-5000 ppm. suspended solids. With the waste water used in this work, these treating conditions led to an optimum value for loading of about 0.5 lb. B.O.D. per day per lb. of suspended solids. This is approximately equal to a loading of 140 lbs. of B.O.D. per day per 1000 cu. ft. of aerator space in a system operated with 4000-5000 ppm. suspended solids.

During the experimental work, the concentration of pollutants in the waste water was allowed to vary in the normal fashion, but the aeration period and the concentration of suspended solids in the aerator were controlled in order to obtain the loading desired for a particular experiment. The data summarized in Table 1 illustrate the effect of loading on the removal of pollutants.

The data in Table I reveal that the average per cent removal of B.O.D. decreased slightly upon increasing the B.O.D. loading over the range examined, and that phenols removal was not significantly influenced by phenols loading within the range ex-

Table 1—Effect of Loading on Effectiveness of Treatment

Exp. No.	Period of Test, Days	Avg. Susp. Solids, ppm	Aeration Period, Hours	Avg. Loading, Lb. Day/Lb. Sludge—— B.O.D.	O.C.	Phenols	Treatment, Avg. % Removal—— B.O.D.	O.C.	Phenols
a	24	5000	12	0.44	0.23	0.018	92	75	94
b	5	7700	8	1.14	0.31	0.024	87	60	90
c	4	6750(2)	4.5		0.39	0.065		75	93
d	8	3800(2)	9		0.35	0.058		71	93
e	10	4100(2)	12	0.71	0.22	0.050	89	58	92
f	10	6350(2)	12	0.46	0.14	0.035	93	67	93

(1) Experiments "c" and "d" were carried out in parallel, using the same feed for the two systems and using portions of the same composited floc in both aerators.
(2) Experiments "e" and "f" were carried out in parallel, using the same feed for the two systems. The suspended solids had slightly different histories.

amined. Although the data concerning loading with O.C. reveal much less over-all agreement, some valid conclusions regarding removal of O.C. could be drawn from the above results.

Experiment "a" gave results which represented most closely the results which could be obtained in a properly loaded system. Results such as those for experiment "a" were readily obtained in a system operated for maximum treatment.

Experiment "b" revealed that a two-to-three-fold increase in the overall loading of a system which had been operating satisfactorily would cause fairly rapid impairment of treating effectiveness.

Experiments "c" and "d" demonstrated that the same treatment of identical feeds with different portions of identical suspended solids was obtained when the concentration of suspended solids and the aeration period were mutually complementary within the range of values examined.

Experiments "e" and "f" revealed an unusually low removal of O.C. in each of the systems. The unsatisfactory removal of O.C. in experiment "e" may have been due in part to overloading of the system with phenols for the week preceding this experiment, although no significant effect on removal of O.C. was noticed during the period of overloading with phenols. The low removal of O.C. by the system with the higher concentration of suspended solids (experiment "f") may have been partly the result of underloading with consequent sloughing off of deteriorated sludge which appeared in the treated product as a colloidal dispersion, thus imparting a high O.C. to the product.

Phenols: it was found that the activated-sludge treater worked highly satisfactorily with normal waste water which contained about 100 ppm. phenols, resulting in a concentration of phenols in the treated product of about 5-10 ppm. A sudden, six-fold increase in the concentration of phenols for two days resulted in definitely impaired treatment for four days, and, judging from the poor results shown for experiment "e", Table 1, it is possible that some lasting damage was sustained by the microorganisms.

A gradual increase in the loading of phenols over a period of ten days, however, allowed the micro-organisms in the suspended solids to become acclimatized to the greater loading of phenols. No decrease in treating effectiveness was noted on treatment of feed containing up to 350 ppm. phenols if the floc was exposed to increases of about 25 ppm. phenols each day. Acclimatization to a concentration of phenols higher than 350 ppm was not studied.

Data are given in Figs. 1 and 2 to show the effect of an increase in the concentration of phenols on the effectiveness of activated-sludge treatment. During treatment of waste water containing an unusually high concentration of phenols the treated product was more deeply colored than normal, thus indicating that the color was largely attributable to oxidation products of phenols.

Acidity: the micro-organisms in the bio-treater were normally acclimatized to pH 8 by feeding waste water which was maintained at pH 8. It was found that a decrease in the pH to a value of 6 over a period of a few days was detrimental. The floc exhibited poor settling characteristics which persisted even when the pH returned to a value of 8, and the removal of O.C. appeared to be somewhat impaired. An increase in acidity of the feed to pH 6, occurring at a time of shock overloading with phenols, resulted in greater impairment of treating efficiency than that observed by shock overloading with phenols in systems operated at pH 8.

The effect of increased acidity at a time of increased loading with phenols is illustrated in Fig. 3. It can be seen that removal of B.O.D. and phenols was normal two days after discontinuing feeding the waste water with the lowest pH and the highest concentration of phenols, but a period of about six days was required before normal removal of O.C. was attained. The floc in the system operated at low pH exhibited poor settling characteristics for one week after returning to feed of normal composition and lengthening the aeration period to 18 hours. During this period of operation, the treating efficiency was not significantly lowered but separation of sludge from the product was obviously less satisfactory.

Alkalinity: another system was acclimatized to a waste water with pH *ca.* 10 by gradually increasing the pH of the feed from 8 to *ca.* 10 over a period of four days. During this period, treatment efficiency was poor due to an earlier experiment in which air was introduced into the aerator at a decreased rate. For the week following acclimatization of the floc, effluent having pH 10 was effectively treated. The removal of phenols averaged 93% and the removal of O.C. averaged 78% from feed having an average composition of 510 ppm. O.C., 95 ppm. phenols, and pH 9.9. It was therefore concluded that the change from pH 8 to pH 10 was not detrimental.

Salt Content: it was demonstrated that the micro-organisms in the activated sludge can tolerate up to 8500 ppm. of dissolved inorganic salts with no significant change in the effectiveness of treatment. There was an indication that the micro-organisms in

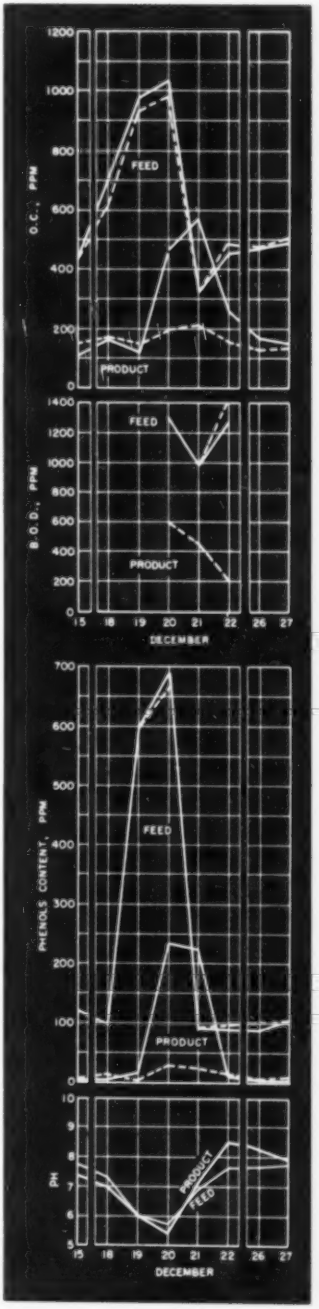

FIG. 3—Effect of increased acidity. Solid line, System C, pH less than 8; broken lines System D, pH at 8

a system with 7000-8000 ppm. of inorganic salts did not recover from overloading with phenols as rapidly as did a normal system having *ca.* 3500 ppm. salts, but this effect was slight. The floc became more dense with an increase in the concentration of salts, presumably from dehydration.

In the experiments to determine the effect of salt content, the concentration of salts was increased daily by stepwise additions over a period of one week until the concentration of inorganic salts in the waste water fed to the treater was enhanced by about 5000 ppm. (2 parts sodium sulfate : 1 part sodium chloride). Then, after two days, the concentration of salts was decreased gradually over a period of one week.

Sulfide: it was demonstrated fairly conclusively that the presence of 1-8 ppm. sulfide for six days impaired the removal of O.C. but did not markedly influence the removal of phenols from effluent. The removal of B.O.D. was not influenced by 1-3 ppm. sulfide for a period of three days, but the removal of O.C. was somewhat impaired. The removal of B.O.D. at a higher concentration of sulfide was not determined, but, judging from removals of O.C. and phenols, a higher concentration of sulfide would have been detrimental with respect to removal of B.O.D.

Satisfactory treating efficiency rapidly returned upon cessation of sulfide addition, indicating that the presence of sulfide for about one week caused no lasting retardation of treatment efficiency. No difficulty was encountered upon treatment for one day of an effluent containing up to 24 ppm. sulfide.

Effect of Operating Variations

Aeration of waste water in the absence of activated sludge resulted in some purification, presumably from chemical and bacterial action. Aeration for either six or twelve hours in a continuous aerator brought about the removal of O.C. and B.O.D. to the extent of *ca.* 10% and 50%, respectively, of the removal obtained in the presence of suspended solids. The removal of phenols was high, being *ca.* 85% of the removal observed in the presence of floc. The possibility that there was significant removal of pollutants by the stripping action of the air does not appear likely since other work showed that no stripping of O.C. and phenols occurred in a normal bio-treater.

In view of the fact that significant removal of O.C., B.O.D., and phenols could be accomplished by aeration, it would be expected that aeration before bio-treatment would result in lessened fluctuation of the loading with less danger of upset to a bio-treater. For a period of one month, waste water was treated in a two-stage system comprising a preaerator and bio-treater, each of the stages having the same capacity. A control, single-stage biological treater was also operated during the first half of this period, identical feed being used in the two systems. The data which were obtained are summarized in Table 2.

It can be seen in Table 2 that normal treatment with activated sludge for twelve hours resulted in somewhat greater removal of O.C. than did pre-aeration for six hours followed by six hours of aeration in the presence of the biological floc. Phenols removal was the same in both instances. B.O.D. removal was slightly less effective in the system with pre-aeration.

This result would indicate that the residence time (total capacity of system ÷ feed rate) in a two-stage system with equal periods of pre-aeration and bio-treatment would have to be slightly larger than the residence time in a one-stage bio-treater in order to get equal treatment, provided the concentrations of suspended solids in the bio-treaters were equal.

It is quite possible that fully equivalent results might be observed from the combination preaerator-bio-treater by suitable adjustment of sludge concentration in the second stage and or relative residence times in the two stages (overall residence-time constant). The sludge volume index and other properties of the floc in the two-stage system were consistently more satisfactory than those of the floc in the single stage system in spite of the slightly poorer treatment.

Product from a bio-treater was recycled to a preaerator to determine whether or not there was an advantage to be gained in the preaerator from the possible presence of enzymes in the recycled stream. For a constant raw feed rate it was found that the presence of the bio-treated recycle actually caused a slight decrease in the removal of pollutants.

Data were gathered which showed fairly conclusively that two-stage biological treatment (i.e., biological floc present in both stages) offered no significant advantage over one-stage treatment, or preaeration followed by single-stage bio-treatment. Two-stage bio-treatment required more careful control than single-stage treatment because it was difficult to maintain a satisfactory environment for the microorganisms in both stages simultaneously.

Chemical clarification of the treated waste water was occasionally required in order to obtain a clear product. It was observed during periods of high turbidity that the removal of O.C. was poor but that removal of B.O.D. and phenols was good. Chemical clarification with 200 ppm. aluminum sulfate usually resulted in decreased turbidity and O.C., the decrease in O.C. relative to the decrease in turbidity becoming greater as the O.C. of the unclarified product increased. It was concluded that the presence of colloidally dispersed, deteriorated floc was mainly responsible for the high O.C. and high turbidity, and that there would perhaps be little need for clarification of product from a properly operated treater.

It was found that the amount of pollutants stripped from the waste water during bio-treatment was so slight that the possibility of air pollution should not constitute a serious objection to activated-sludge treatment. Phenols were not stripped, and O.C. and ammonia were stripped to the extent of 0.4 ppm. and 0.6 ppm. on the basis of the waste-water feed. These values were 0.1% and 1.5% of the O.C. and ammonia, respectively, in the waste water undergoing treatment. The used air had a not-unpleasant musty odor which was very similar to that of air from a bio-treater for domestic sewage.

Table 2—Preaeration Followed by Bio-Treatment, vs. Single Stage Bio-Treatment

	Preaeration Followed by Bio Treatment		Single-Stage Bio-Treatment	
Composition of Feed:	**Min.-Max.**	**Avg. Value**	**Min.-Max.**	**Avg. Value**
B.O.D., ppm.	670-1400	1110	670-1320	960
O.C., ppm.	500-1060	820	520-1060	810
Phenols, ppm.	58-250	105	80-150	115
Conditions of Treatment:				
Aeration period, hr.:				
Preaeration		6		0
Bio-treatment		6		12
Suspended solids, ppm.	3700-6000	5050	4080-6180	5115
Effectiveness of Treatment:				
B.O.D. removal, %	87-98	92	84-99	95
O.C. removal, %	53-85	68	67-90	77
Phenols removal, %	94-97	95	86-98	93

The author wishes to acknowledge the valuable assistance of S. York, who did much of the laboratory work; P. D. Crebbin, who prepared and analyzed many of the samples; and R. A. Bannerot, who offered numerous helpful suggestions and criticisms.

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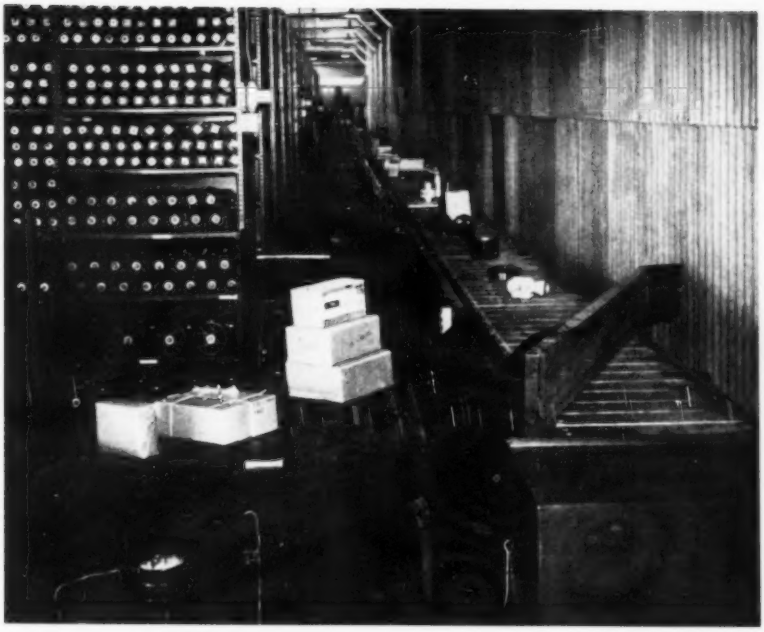


FASTER DELIVERY of orders is facilitated by this continuous conveyor, over 200 ft. long, in Shell's main warehouse

How Fast Do Your Stores Move?

Efficient streamlined operation in Shell's new warehouse at Wood River was the result of long, careful planning

By J. E. BREWER
Shell Oil Co., Wood River, Ill.

MORE efficient material handling and speedier filling of materials orders with a $10,000,000 per year monetary turnover of stock has been an important result of consolidating the stores department operations at Shell Oil Co.'s Wood River, Ill., refinery.

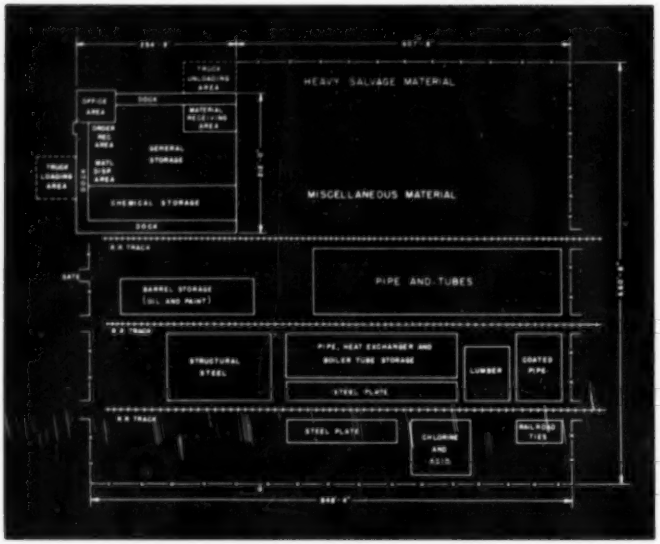
A new warehouse and adjacent outdoor stores area, completed late in 1951 and providing some 550,000 sq. ft. of space, is the focal point of the warehousing operations at this 140,000 b.d. plant. A carefully-planned organization plus such physical facilities as a pneumatic tube system, loudspeaker "intercom," conveyor belt, palletizing wherever possible, and full use of fork-lift trucks have all contributed to streamlining the work of the department.

The stores department is responsible for procuring, storing, issuing, delivering, and salvaging materials plus the related accounting functions. To fulfill these responsibilities, the department employs 87 people. A total of 20,000 items are stored, with an approximate value of $2,750,000. In addition to materials stored for general maintenance and operation, the following quantities of basic types of refinery equipment are covered by replacements and parts storage: 2000 pumps, 154 fractionating and distillation columns, 1244 pressure vessels, 1620 heat exchangers, 70 furnaces, 4000 instruments.

In 1923, the first stores building was erected at the Wood River refinery. As a result of subsequent refinery expansion, materials "overflowed" through the years into three materials yards and numerous buildings. These widespread operations resulted in a general lack of control over materials and highly inefficient operation which, of course, reflected in the overall cost of operating the stores department as well as the refinery. The new stores facility, completed at a cost exceeding $500,000, is designed to correct this situation.

It is located in close proximity to the refinery fabrication shop to facilitate co-ordination between these two highly important phases of refinery operation.

Careful consideration has been given to providing facilities for rapid handling of orders as well as materials. For handling materials orders and other "paper work," the warehouse building is equipped with a network of 11 pairs of pneumatic tubes. An inter-communication system, with 24 stations was provided for expediting verbal contacts. Master stations through which calls may be initiated or received are located in the offices of top departmental supervision, in the receiving and shipping room, at the material dispatching station, and at the order receiving point. There are also three sub-stations in the offices, 11 in the building proper, and one on the outside building wall, with a range over the entire yard, through which calls may be received and



GENERAL LAYOUT of entire new stores area at Wood River

PALLETIZED DRUM storage in the outdoor materials yard

SHIP-SHAPE PIPE storage with 15-ton crane for handling

KING-SIZE VACUUM CLEANER in bagged chemicals storage

Fast Stores Operation

conversation carried on with the initiator.

The material handling and storage section of the warehouse building is 180 ft. wide by 240 ft. long. This portion of the building consists of five general sections: 1) receiving and shipping, 2) general storage, 3) order receiving and dispatching, 4) material dispatching, and 5) chemical storage.

Four fork lift trucks and a 208-ft. long conveyor (extending almost the entire length of the building) provide material handling service. Storage by palletization is employed to the fullest extent possible. As shown in the illustrations, it includes palletization of such things as valves and bags of dry chemicals. Groups of irregularly shaped objects are also palletized and the pallets stored on metal racks, rather than being piled one on top of the other. Where pallets are impractical, various types of conventional bins, racks, and the like are used.

The flat roof over this section of the building slopes toward, and drains from, the middle rather than the outer edges. This prevents water drainage at the loading and unloading docks which extend along one end and both sides of the building. The roof extends completely over each dock. Ceiling height is 15 ft. to allow for maximum storage by palletization. The floor, a maroon colored concrete, is designed to withstand 750 lbs./sq. ft. Walls are buff brick, 4 ft. high, above which is transite except for a solid brick partitioning wall between the office and the main storage area.

The chemical storage section of the building is unheated. The remainder is heated by ceiling-mounted, thermostatically-controlled, low pressure steam, blow-type unit heaters. All artificial lighting is by incandescent lamps. Two lavatories are

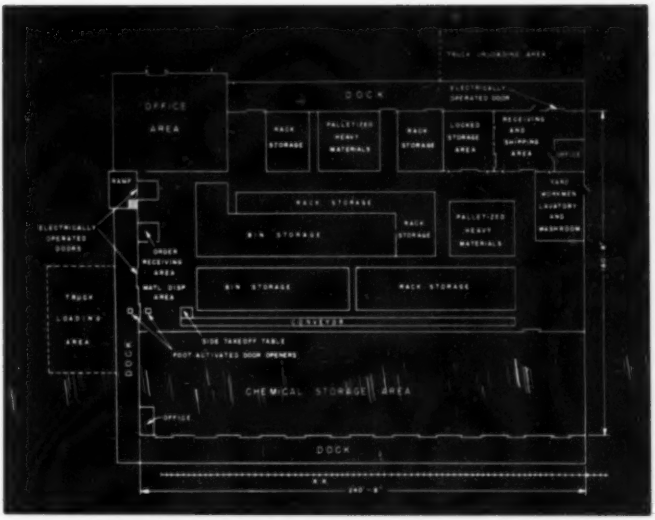
accessible from this section. One located over the office is used by workmen inside the building. The other at the opposite end of the building is for workmen both in the building and the material yard.

All heavy, frequently used doors are electrically operated. The door at the material dispatching area is activated from within or outside by foot contact with a floor control. The doors in the chemical section are operated from the outside. This permits maximum storage flush with the inside of the door.

The outside storage yard is about 662 ft. wide by 848 ft. long, and covers approximately 13 acres. It is completely enclosed with a 6-ft. high, chain link type fence, and is well lighted. Three railroad spurs enter the yard and provide a total approximate length of one-half mile. Primarily heavy materials are stored in the area, such as pipe and tubes, lumber, drums, steel plate, etc.

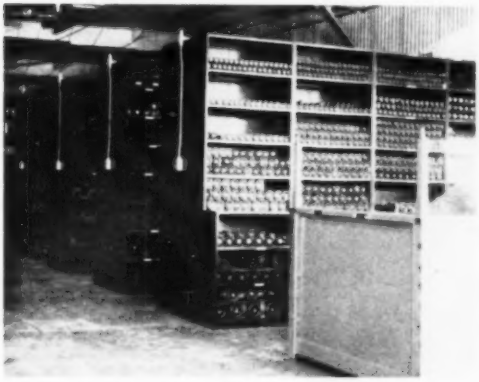
Handling is done with a pneumatic-tired, 15-ton crane, and a 4000-lb. and a 5000-lb., gasoline-powered, pneumatic-tired fork lift truck. The area in front of each dock is paved with asphalted concrete to a distance of about 50 ft. to facilitate operation of the three heavy trucks or other vehicles. Remaining roadways and storage areas are heavily covered with limestone rock and penetration asphalt.

The new stores building location has permitted a general streamlining of procedures plus pin-pointing of responsibilities which had previously been impossible. This has resulted in a reduction in the number of personnel with supervisory jurisdiction and a simplification of the department's organization. The organization now consists of four sections: 1) one responsible for material procurement and maintenance of stocks



MAIN STORES BUILDING, general layout and floor plan

PALLETIZED VALVES and other fittings inside main building



BIN STORAGE BEST for smaller packages

PALLET-RACK combination most suitable for irregular shapes

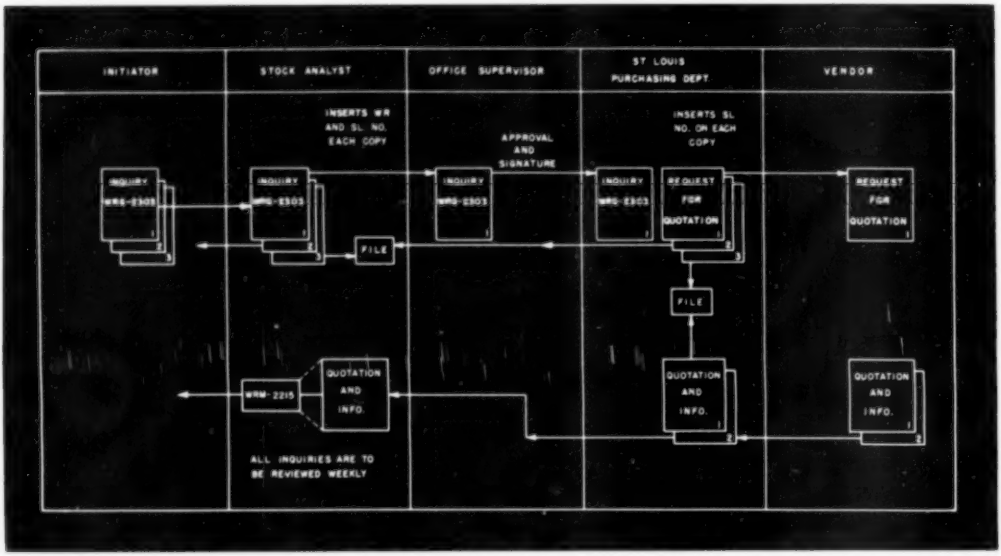


FIG. 1 Procedure diagram for following up inquiries

plus departmental accounting functions; 2) another for the receipt, storage, issuance, delivery, and salvaging of materials; 3) another for inventory; and 4) a priorities group.

Office personnel responsible for procuring materials and maintaining stocks were departmentalized. For example, one man assumed these responsibilities for mechanical equipment, another for pipefitter materials, etc. Likewise, workmen assigned to actual storing and issuing of materials were departmentalized. One man verifies that materials issued conform to the materials ordered and that they are delivered to the proper refinery location at the correct time.

Concurrent with the consolidation of operations and reorganization, a thorough study of existent procedures was instigated. To facilitate this study, the procedures in operation are being laid out on diagrams such as shown in Fig. 1, which shows one particular procedure that of obtaining inquiries, and how the stores department functions tie in with the main purchasing department.

The office section of the building is two stories high. The first floor is divided into seven sections: a reception room, four offices, an accounting, priorities, and inventory section; and a section for the personnel charged with procurement and stocking responsibilities. The second floor has lavatories, washrooms, record storage, and the air conditioning and heating equipment.

The roof is flat; the floor is concrete faced with brown asphalt tile. Exterior is buff colored brick and glass. Walls inside are plastered and are painted light green as is the woodwork, except the doors which are light oak. Ceiling is conventional metal pan acoustic type. Illumination is by flush type, fluorescent fixtures. Baseboard radiant type heat is provided with water as the heating medium. Air-conditioning is installed for the entire office. The equipment is a combination unit, equipped with a steam coil as a supplement to the baseboard radiant heat during the winter months. Air conditioner ducts and outlets are located between the ceiling and the second floor. At each outlet, the acoustic pads are removed from the metal pans to allow air passage through the perforations.

Architectural designing of the building was handled by Engineering Systems, Inc., Chicago. Personnel of the Shell purchasing-stores and engineering departments handled all other phases of designing and planning.

Meet the Author

John E. Brewer, assistant stores manager, Shell Oil Co., Wood River, Ill., went into refinery warehousing operations with an engineering background. He has spent his entire 13-year working career with Shell at that plant.

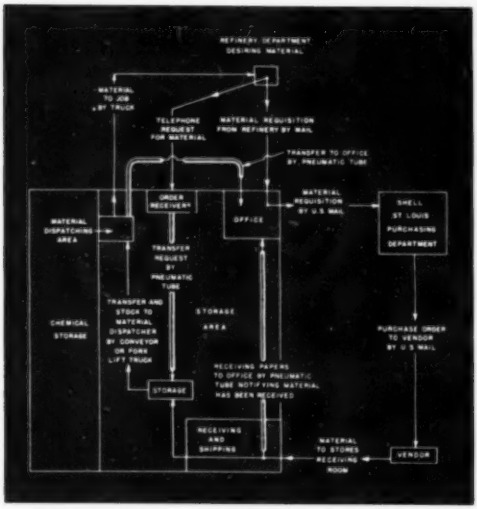
Mr. Brewer started with Shell in 1939 as an assistant fireman and boiler washer. In August, 1942, he was promoted to the job of refinery engineering inspector, and in 1946 was made assistant chief inspector for the refinery, which position he held until April, 1951, when he was transferred to his present post in the purchasing-stores department. He spent the major part of his time in planning the new building.

Born in St. Louis, Mr. Brewer received his grade and high school education in Granite City, Ill. He has been studying in the evening school at Washington University, with a goal of B. S., majoring in engineering and metallurgy.

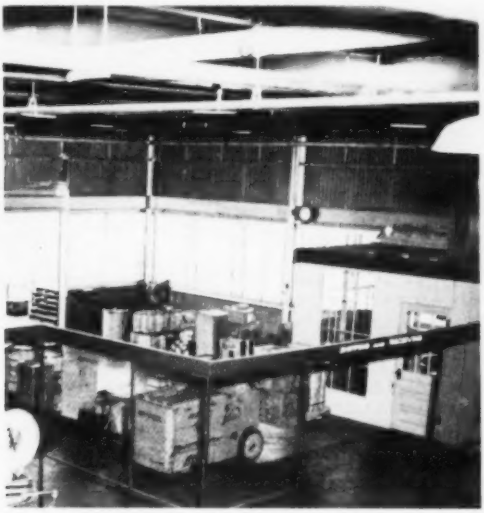
He lives in Granite City, with his wife and two small children. Mr. Brewer is on the board of directors of the St. Louis chapter of the American Welding Society.

ORDERS ARE FILLED and then forwarded to refinery

ORDERS RECEIVERS shoot requests to stock attendants or to purchasing via stores building office


REFINERY DEPARTMENT DESIRING MATERIAL
MATERIAL TO JOB BY TRUCK
TELEPHONE REQUEST FOR MATERIAL
MATERIAL REQUISITION FROM REFINERY BY MAIL
TRANSFER TO OFFICE BY PNEUMATIC TUBE
ORDER RECEIVERS
OFFICE
MATERIAL REQUISITION BY U.S. MAIL
SHELL ST. LOUIS PURCHASING DEPARTMENT
MATERIAL DISPATCHING AREA
TRANSFER REQUEST BY PNEUMATIC TUBE
CHEMICAL STORAGE
TRANSFER AND STOCK TO MATERIAL DISPATCHER BY CONVEYOR OR FORK LIFT TRUCK
STORAGE AREA
PURCHASE ORDER TO VENDOR BY U.S. MAIL
RECEIVING PAPERS TO OFFICE BY PNEUMATIC TUBE NOTIFYING MATERIAL HAS BEEN RECEIVED
STORAGE
RECEIVING AND SHIPPING
MATERIAL TO STORES RECEIVING ROOM
VENDOR

FLOW PLAN of orders and stock through stores building



NEW STOCK enters at the receiving and shipping room

How Orders Are Expedited

THE basic procedure in moving materials from the stores building to the refinery department is shown in the above flow plan. When the material is in stock, order receivers take telephoned requests from the refinery and send a written request by pneumatic tube to the proper point in the storage area. Material is then transferred by conveyor or fork lift truck to the material dispatcher, and thence to the refinery by truck.

When material is not in stock, a requisition goes by plant mail to the stores department office. The man responsible for procurement of that particular type of material verifies that neither the desired item nor a suitable substitute is in stock. He then forwards the requisition to a buyer in the company's St. Louis purchasing department office who places the order with the vendor.

When the item arrives at the plant, receiving and shipping room personnel make sure it conforms with the order and then transmit it to storage. Concurrently, receiving papers are forwarded to the stores department office via pneumatic tube, for accounting purposes. As soon as the item requisitioned is required by the refinery, it is ordered by telephone request to the order receiver. As filled orders pass through the material dispatching area, they are verified and the transfer request sent by pneumatic tube to the office for accounting purposes.

Standard stock inventory make-up is carried on conventionally, with orders and requisitions to purchasing originating in the stores office.

APPLICATIONS FOR

Continuous Viscosimetry

'In-plant' operation eliminates lost hours of laboratory viscosity measurements

By R. W. FRITZSCHE
Fischer & Porter Co.

EQUIPMENT developed for measuring fluid viscosity continuously and automatically offers the process engineer a new means for controlling his refinery operations.

In the past, viscosity measurement has been a matter of withdrawing presumably representative samples and conducting time-consuming laboratory analyses. According to the nature of the sample and the preference of the industry, one or more of many reliable "batch type" viscometers are used. The quality control laboratory in a typical refinery performs more than 300 viscosity determinations daily.[1] Often the backlog of samples awaiting analysis accounts for the loss of two or three hours between the operator's removal of a sample and his receipt of the laboratory report, which is frequently without value due to changes within the process during the elapsed time.

Viscosity measurement need not be a costly, time-consuming laboratory operation in modern production. Continuous viscosimeters at their present stage of development are reliable for:

1) Fully-automatic operation of vacuum distillation units in the lube oil plant where improved fractionation and product uniformity provide the justification.

2) Continuous blending of fuel oils and cutback asphalts or road oils where the payout appears in reduced storage capacity for blended materials.

3) Tender identification in crude oil pipeline service where instantaneous interface detection can reduce contamination or diversion to slop tanks.

4) Controlling viscosity of bunker fuels directly instead of by use of the conventional temperature controller, which, regardless of viscosity, delivers steam at the rate required for the most extreme conditions; and

5) for many other processing requirements.

This article will classify the several types of industrial viscosity measurement, describe the most popular viscosimeters in present use, and discuss conditions upon which successful application of viscosity sensitive instruments relies. It is assumed that the reader is generally familiar with the concept of viscosity and units of measurement. Design considerations, pertinent to the basic viscosity-sensitive apparatus, will be treated in the broad sense and included only for their illustrative usefulness.

Classification of Viscosimeter Usage

Liquid fluids to which continuous viscosity measurement is applicable group generally as Newtonian or non-Newtonian. The former exhibits characteristics of "true viscosity" wherein, for a given fluid, viscosity is fixed at a selected temperature and pressure. Typical Newtonian fluids are most petroleum oils, glucose solutions, glycerols, and water. The non-Newtonian group behaves differently, viscosity is not constant at a given temperature and pressure, but is a function only of shear stress. This quality is evident in such fluids as mayonnaise, printing ink, drilling mud, and paints.

The complexity and scope of the application of instruments for continuous viscosity measurement leads to the following subdivisions:

Class A—Operating Viscosity—Industrial measurement and control of the viscosity of Newtonian fluids at operating conditions without regard for temperature and in the lower region of viscosity values below about 500 centipoise. In this category, viscosity measurement or control becomes an operating aid as in the control of fuel oil viscosity as a combustion aid.

Class B—Contract Viscosity—Viscosity measurement and control chiefly in petroleum refineries where measurement proceeds at operating temperatures with compensation or correction to base temperature or where measurement proceeds with a continuous sample whose temperature is carefully controlled at the base value. These applications generally presume Newtonian fluid characteristics and the lower range of viscosity values below 500 centipoise. Such usage is typified by the control of lubricating oil viscosity.

Class C—High Viscosity—Measurement and or control with a Newtonian fluid whose viscosity is above 500 centipoise, such as grease or road oil.

Class D — Apparent Viscosity — Measurement and or control of what may be called "consistency" when the flowing medium has non-Newtonian characteristics. This group is most common in textile, food, printing, and

Meet the Author

Robert W. Fritzsche, author of this paper on continuous viscosimetry, has been in the petroleum field for 13 years and in instruments for 10. After obtaining a diploma in petroleum engineering he went to work with the Petrol Corp. in Philadelphia in 1939 as a Petroleum and Service Engineer. In 1942 he went with Energy Control Co. in the same city, and specialized in instruments for combustion and process applications.

He has been with Fischer & Porter Co. since 1944 as a sales engineer, and in the Southwest most of the time. At present he is Regional Sales Manager for the company in the Southwest, with offices in Dallas.

various industries outside petroleum.

Class E—Penetration—A combination of Class B and C viscosity measurement with asphalts or plastics that have predictable properties relating penetration in the solid phase to viscosity in the liquid phase. In general, reliability of the correlation is enhanced by cooling the medium to a semi-solid state and conducting measurement at a carefully controlled temperature as close as possible to the base penetration temperature.

Obviously, considerations in the selection and application of viscosity-sensitive apparatus differ with each group. For example, in Class B requirements, the viscosity index of a particular petroleum oil dictates the degree of refinement required for temperature control or compensation. Low viscosity index oils demonstrate wide viscosity variation for small deviations of temperature as shown in Table I.

Thoroughly dependable viscosity measurement in the case of Oil D between 80 and 100° F. demands accurate control of temperature within ±0.1° F. Successful measurement or control is often, therefore, related to the choice of temperature-sensitive instruments, heat exchanger design, heating medium, sampling point and similar considerations that influence the conditions under which viscosity is to be measured.

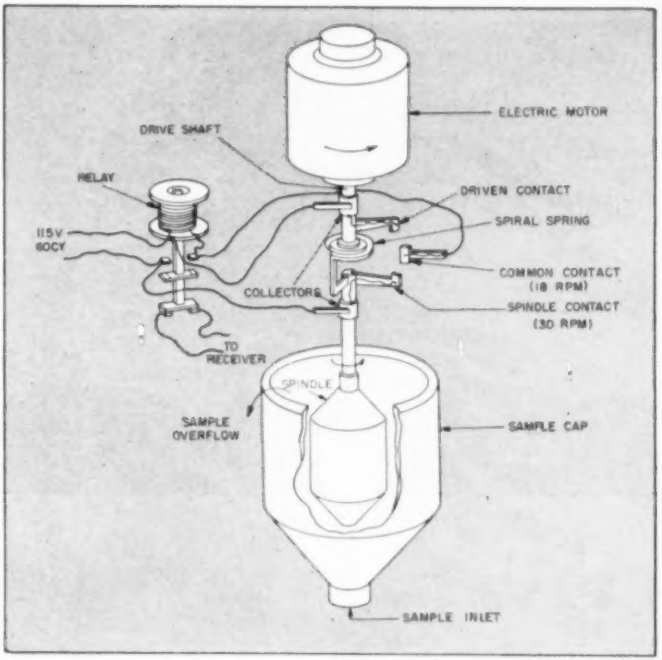


FIG. 1 Rotational type viscosimeter[3]

Types of Continuous Viscosimeters

Development of the art of continuous viscosimetry has extended in four directions chiefly from three independent sources. Experimental data has been accumulated through more than ten years of laboratory development and "in-plant" application. In each case operation of the viscosity-sensitive unit depends upon a physical component to impose a predetermined shear stress upon the sampled material. More recently, announcement has been made of an electronic device[2] which correlates fluid viscosity with ultrasonic signals. This article, however, will be confined to those mechano-hydraulic devices that have enjoyed more widespread usage and have, therefore, achieved a degree of predictability and economy that must probably await further development of the ultrasonic device.

Rotational Type Viscosimeter[3]

This instrument (shown in Fig. 1) employs a spindle, which is submerged in the material and rotated at a constant speed, as the viscosity-sensitive element. The spindle is coupled, through a calibrated beryllium-copper hair spring, to the shaft of a synchronous motor and is rotated at approximately 30 rpm. The calibrated spring is adjusted to be unstressed when the spindle is rotated in air. Upon submergence in a liquid, torque is exerted against the spindle causing angular deflection of the spring in proportion to viscosity.

It is the angular displacement between spindle and motor shafts that is calibrated in appropriate units of viscosity measurement. The sample flows within an annular space between concentric cylinders which are the spindle and the sample chamber, or baffle. Recording or recording-controlling instruments detect the amount of spring deflection by an electrical contact and relay system or by microtorque potentiometer.

Such viscosimeters are quite versatile in their adaptability to wide ranges of viscosity and the nature of the fluid; design variations permit a choice of cylinder diameter ratio or spindle type (i.e.: cylinder, disc, paddle, a number of cups) to suit most operating conditions.

Rotational type viscosimeters have been applied chiefly to non-Newtonian materials as starch, size solutions, paints and varnishes, as a result of their particular suitability to such service. They are generally non-clogging, applicable to agitated solutions, and reasonably easy to clean. Some are supplied with built-in solvent sprays for periodic cleaning with negligible service interruption. Such units perform satisfactorily at viscosity values as high as 50,000 centipoise and claim accuracy within 1% of full range for a given instrument. They satisfy most of the requirements of Class A and D viscosimeter duty previously described. It should be borne in mind, however,

Table 1—Effect of Slight Temperature Variations on Viscosities of Low V. I. Oils

OIL	Viscosity in CKS. at				Average % change in viscosity per °F change in temperature	
	210° F	180° F	100° F	80° F	100-80	210-180
A	4.36	6.16	24.95	41.9	3.4	1.38
B	4.26	6.48	34.08	64.9	4.5	1.62
C	15.8	25.68	176.3	365.0	5.4	2.1
D	15.8	29.12	362.0	957.0	8.2	2.8

* Carson and Heidrich—*Petroleum Refiner* Vol. 26, P. 123, Feb. 1947

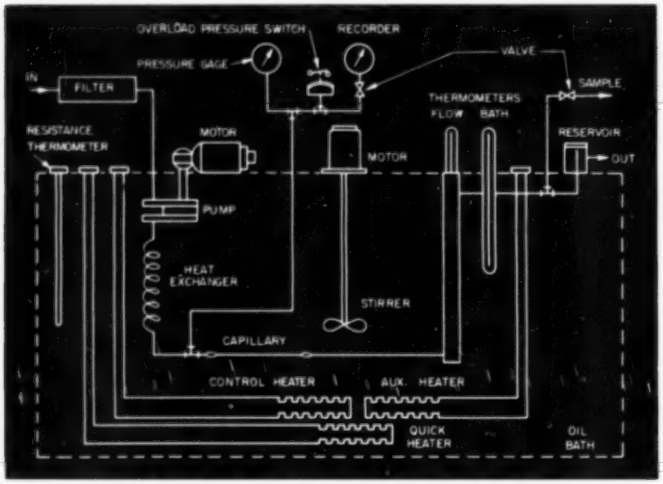


FIG. 2—Flow diagram of capillary type viscosimeter(4)

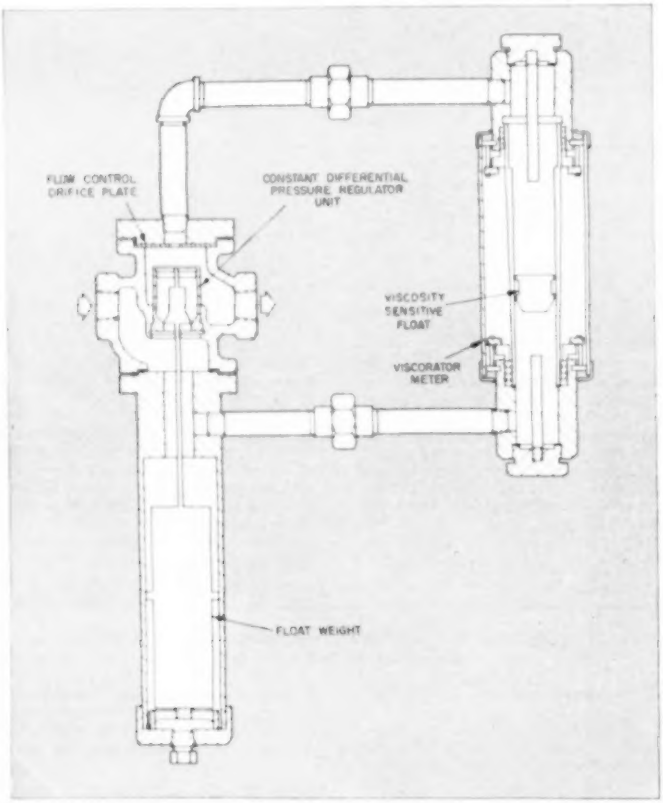


FIG. 3—Float type viscosimeter with flow regulator(5)

that carefully controlled electrical frequency is essential to proper operation with non-Newtonian materials since their apparent viscosity is related to shear stress and shear stress is a function of spindle speed.

Capillary Type Viscosimeter(4)

The capillary type viscosimeter utilizes the principle expressed in Poiseuille's Law which states that viscosity is directly proportional to pressure loss across a capillary when liquid is pumped through the capillary at a constant rate. Since Poiseuille's Law is valid only at Reynolds numbers below about 1200, in the laminar region, flow rate must be maintained constant at approximately 50 ml./min.

Liquid is delivered to the capillary by a small positive displacement type metering pump driven by a synchronous motor. Pressure downstream from the capillary is maintained constant by a reservoir so pressure loss variations imposed by changes in viscosity are reflected accurately in upstream pressure measurement. The recording instrument is a simple pressure recorder in which pen deflection has been calibrated in poises.

There is nothing new about the capillary principle of viscosity measurement except its application to industrial requirements. This was accomplished by the combination of extremely sensitive temperature instrumentation, a highly precise metering pump which is machined to a tolerance of 25 micro inches, and carefully designed heat exchange facilities. Capillary entrance and exit effects were made insignificant by experimental calibration with fluids having known viscosity.

One petroleum refiner has built and successfully applied the unit shown in Fig. 2 at a lubricating oil plant, where it measures the viscosity of waxy raffinate in a phenol extraction unit; the range of viscosity is from 50 to 140 SSU at 210° F. The designers claim accuracy better than 1% in a given viscosity determination. Further use contemplates installations on light redistillate oil at 30-45 SSU at 210° F., pressure distillate gas oil at 150-180 SSF at 210° F., and other petroleum products with intermediate ranges of viscosity.

The capillary type viscosimeter offers a reasonable approach to Class A, B, and C viscosity measurement. Evidently, ample provision was made in the illustrated unit, for minimizing the volume of fluid in transit to effect maximum speed in the detection of viscosity changes. The very low sample rate complicates application of the capillary principle to automatic control where sample turnover can introduce a prohibitive time lag.

Float Type Viscosimeter[5]

This instrument employs a vertical tapered tube, large end up, and a weight which moves within it. Fluid is delivered to the bottom of the tube; it then flows upward and is discharged at the top. The weight is designed to expose large surface area to viscous force in the flowing stream and is dragged upward as higher viscosity increases adhesion between the fluid and the weight. This is, of course, an adaptation of the rotameter type flowmeter in which movement of the weight is also a response to velocity changes. Several devices are in use for the maintenance of uniform velocity or flow rate under which condition the elevation of the weight can be calibrated empirically in appropriate units of viscosity measurement.

As with the capillary type viscosimeter, flow rate is commonly maintained constant by a positive displacement type metering pump with synchronous electric motor drive in a Class A viscosimeter installation.

Another flow regulating device is shown in Fig. 3. Here, the sample is delivered under line pressure or by a circulating pump to the underside of a heavily-loaded plug which is free to rise above a $\frac{1}{4}$-in. long seat tapered at an angle of 45°. This element is in essence a low-lift, self-operating controller which maintains fixed pressure differential across an orifice for uniform flow rate regulations. As flow rate to the regulator increases, the plug is forced to rise in accordance with the classic equation:

$$Q = A(2gh)^{.2}$$

where

Q = flowing quantity,
A = cross sectional area of the aperture,
g = gravity constant (32.16), and
h = head loss.

Head loss, owing to the weighted plug, is constant. Thus, the device performs, as a "souped-up" area type flowmeter.

Viscous effects in the flow regulator are made negligible by the shape of the plug, the heavy weight it supports, and the selection of orifice diameter. Viscous influence in such a device is proportional to the ratio of absolute viscosity to plug weight. Here, the plug is so heavily loaded that viscosity variations up to 400 centipoises cannot affect the characteristics of the regulator. The d/D ratio at the orifice flow control plate is kept below 0.1 to establish the uniform discharge coefficient necessary for reliable performance. Class A and Class B flow diagrams are shown in Figs. 4 and 5.

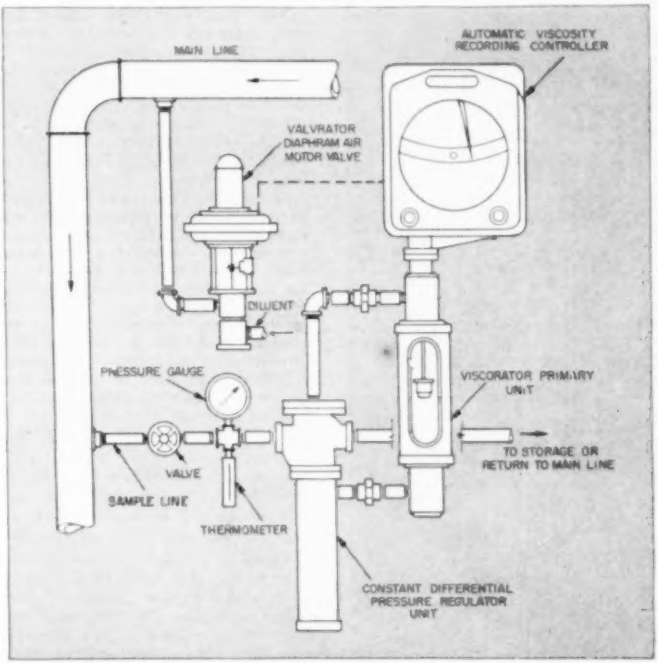


FIG. 4 Class A hookup of float type viscosimeter-pipeline sampling

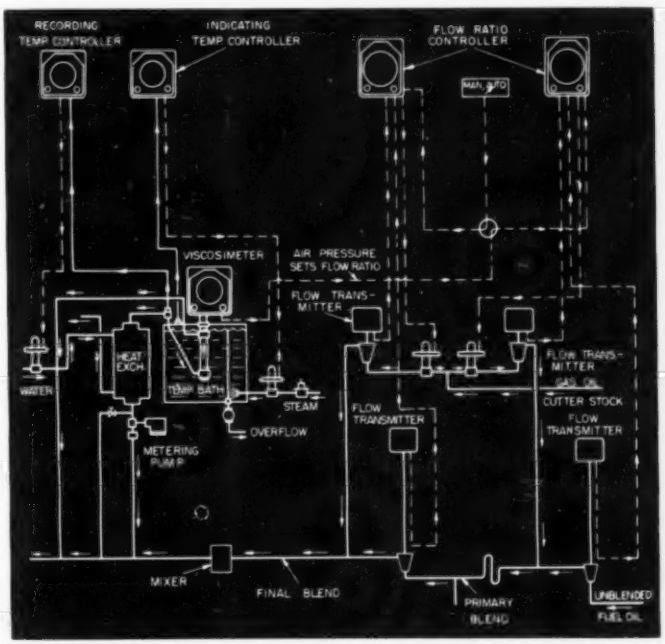


FIG. 5 Fuel oil viscosity blending control system (Class B)

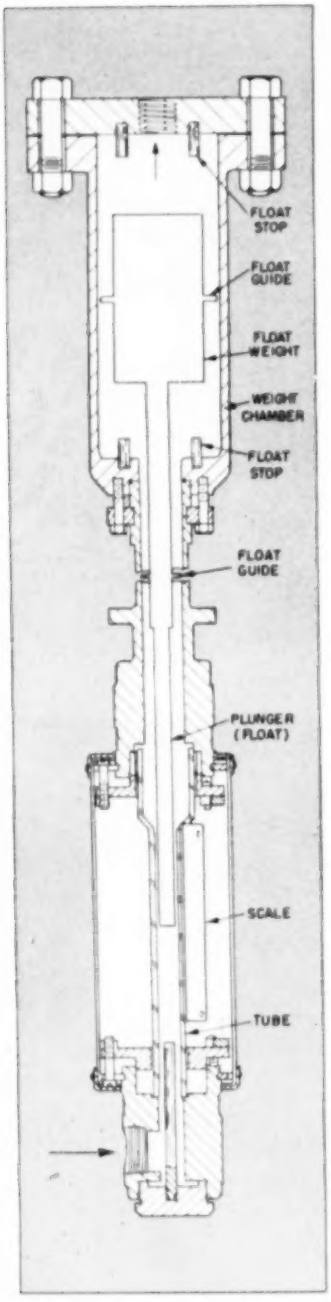


FIG. 6 Plunger type viscosimeter[5]

The float type viscosimeter has been applied to cement slurry, starches, catsup, and many petroleum products. When supplied with a Pyrex glass tube it provides a particularly simple and reliable operating guide. Since it performs in a closed system, evaporative or hygroscopic deterioration of the sample is not a possibility.

Metal tubes have also been supplied, encased in steam jackets or surrounded by electrical strip heaters, for high melting point materials as asphalt. The float in such instruments carries a strong magnet which actuates a recording or controlling instrument by magnetic coupling or a soft iron armature which is used for transmission to remote exhibiting instruments in a series-resonant circuit resembling the conventional impedance bridge.

Since viscosity sensitivity in the float type viscosimeter is related to float weight and float weight is, in turn, related to flow rate, flow requirements add to other considerations in the application of this instrument. In Class A and B installations, the relatively high sample rates shown in the following table often constitute an advantage in more rapid response. The importance of the time element, however, must be balanced against the added cost of larger heat exchange apparatus in Class B applications.

Viscosity Range Centipoise		Flow Rate GPM
Maximum	Minimum	
5	0.5	0.4
10	1	0.8
30	3	1.0
60	6	2.0
90	9	2.5
120	12	3.0
180	18	4.0
230	23	5.0
400	40	6.0

Plunger Type Viscosimeter[5]

The plunger type viscosimeter is shown in Fig. 6. It consists essentially of a weighted cylindrical plunger arranged concentrically within a uniform-bore section of Pyrex tubing formed to precise dimensional specifications. The tube is typically 6 in. long with 0.375-in. bore diameter, the plunger is approximately 0.25-in. O.D. and weighted to about 5000 gr. Fluid enters beneath the plunger and flows upward through the narrow annulus to the enlarged section at the tube outlet. Uniform shear stress is imposed by the plunger whose elevation is inversely proportional to rate of shear when flow rate is constant. Thus, increasing viscosity forces the plunger to rise and thereby reduces the length of plunger rod or surface area exposed to viscous drag. Since the height to which the plunger is lifted is a function of surface area and viscosity, dynamic balance is established when the plunger rises above the tube enough to produce the reduction of surface area that satisfies the increased viscosity.

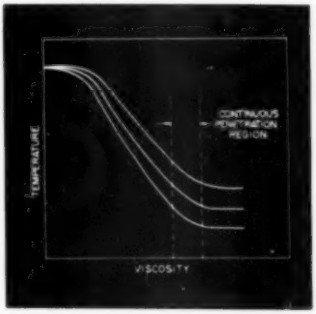


FIG. 7 Generalized curve of asphalt viscosity-temperature relationship

A small metering pump driven by a synchronous motor is used to maintain uniform flow at some point between 6 and 600 cm³/min. depending upon the range of viscosity which is inversely proportional to sample flow rate. For example, a plunger type viscosimeter designed for 500 poise capacity at a sampling rate of 100 cm³/min. can be adapted to 1000 poise maximum capacity by reducing the sample rate to 50 cm³/min.

These instruments are especially suitable for viscosity measurement in Class B, C, D and E applications. Their primary field of usage is in the higher regions of viscosity above 400 centipoise. Experimental work that led to subsequent industrial installations was performed with nylon size solution with viscosity to 1000 poises.

The characteristic uniformity and high value of shear stress minimizes non-Newtonian influence and makes it particularly suitable for use with complex fluids. Recording, controlling and various accessory requirements are accommodated as with the float type viscosimeter.

Penetration

The plunger-type viscosimeter offers the fascinating possibility of Class E automatic control of asphalt penetration. Fig. 7 shows the generalized temperature-viscosity correlation for asphalts produced from different crudes. The slope of the curves, owing to the viscosity index of the crude petroleum, is such that each is most identifiable just above the freezing point. In this region, usually between 120° F. and 140° F., viscosity may approach 1000 poises.

At these values, the semi-solid and the solid at slightly lower temperatures are sufficiently alike to permit reliable viscosity-penetration correlation. Since viscosity is inversely related to penetration, it is simply necessary to invert the normal viscosimeter scale and to calibrate it in terms of equivalent penetration at 77° F. while measurement proceeds at, say, 140° F.

Temperature Compensation

Attempts to control sample temperature for Class B requirements within the limits often required by low viscosity-index petroleum oils have been generally frustrating because of inherent lags in the heat exchange system. It was decided, therefore, in a recent application of the float type viscosimeter, to arrange a heat exchange coil within a temperature bath to approximate the base temperature of 210° F. (plus or minus 10° F.) and to use a secondary temperature transmitter for temperature compensation in a dual receiving instrument.

The viscosimeter was built with a pneumatic transmitter which transmitted a 3-15 psi signal, proportional to viscosity, to a receiver bellows inside the recording instrument. A cam was inserted between the bellows and the recording pen to produce a scale which duplicated ASTM chart D341-32T. The temperature compensating receiver bellows was then arranged to shift the instruments zero point for temperature compensation over the entire range as long as the temperature-viscosity relationship was linear on the ASTM chart and viscosity index was constant. This technique is, of course, adaptable to any of the recording viscosimeters that have been described.

Specific Gravity Correction

Specific gravity changes and viscosity variations are frequently simultaneous, particularly when the latter results from unstable temperature. Since absolute viscosity bears no relation to mass density, greater simplicity attends measurement in absolute units (poise) as the result of freedom from errors that would otherwise be introduced by specific gravity changes.

It will be apparent that force against the spindle due to specific gravity is exerted perpendicular to the viscosity-imposed torque in the rotational type viscosimeter. Viscosity measurement is, therefore, accomplished without regard for mass density. Similarly, mass density does not appear in Poiseuille's Law and viscosity measurement by capillary is immune to its influence. The float in the float-type viscosimeter, on the other hand, will respond to the combined influence of density and viscosity, when the sample rate is controlled by a motoring pump, because it is buoyed more or less as the weight of the fluid it displaces increases or decreases.

When the uniformity of flow rate is regulated by the plug-operated flow controller (Fig. 4), however, the effect of density variation is to alter the net plug weight and, therefore, the pressure differential imposed by the weighted plug. The modified pressure differential causes the rate of flow through the flow control orifice to vary an amount that is almost exactly the mathematical equivalent of the density correction that would otherwise apply. Thus, the float type viscosimeter and companion regulator are affected in equal magnitude but in opposite directions and mutual compensation for changes in mass density results.

If, in the plunger-type viscosimeter, the weight-housing chamber is filled with a fluid having known and uniform specific gravity, variations in density of the sample fluid will have virtually no effect upon the viscosity calibration of the instrument because the ratio of weight volume to plunger volume is so high that buoyant effects on the plunger rod are nearly cancelled.

Summary

Today, the process or instruments engineer has access to reasonable selection of viscosity-sensitive instruments and can therefore design an automatic control system in which viscosity is the primary variable. The success of his effort will depend largely upon proper classification of the requirements; selection of a suitable principle of viscosity measurement with respect to inherent or externally-imposed time lag, sensitivity, and accuracy, and the degree of refinement attending complementary heat exchange apparatus or temperature control instrumentation.

Indeed, it takes little imagination to visualize a continuous viscosity index recorder which simply requires the proper integration of instrument components whenever industry expresses the need for it.

References

(1) D. J. Pompeo. "Application of Viscosity Measurement in Petroleum Refining Operations." *Petroleum Refiner*, Vol. 26, pp. 101-103, Nov. 1947.
(2) Rich-Roth Laboratories, East Hartford, Conn.
(3) Brookfield Laboratories, Stoughton, Mass.
(4) From a paper delivered by D. J. Pompeo before the Third World Petroleum Congress, May 28-June 6, 1951, The Hague, Holland.
(5) Fischer & Porter Co., Hatboro, Pa.

Source

This paper was delivered before the semi-annual meeting of the American Society of Mechanical Engineers held at the Sheraton-Gibson Hotel in Cincinnati, Ohio, June 15-19, 1952.

Refinery Expansion 36% Complete

THE nation's refining industry now has a little over one-third of its planned expansion already built under the rapid tax write-off program, according to a mid-1952 progress report to President Truman by the Council of Economic Advisers.

Of the total expenditure of $1.2 billion planned refinery expansion, $777 million has been granted tax write-offs by the Defense Production Administration, and 36% of that has actually been constructed, CEA stated. Six months ago the amount built was 24%.

Petroleum Administration for Defense had through April of this year recommended to DPA fast tax write-offs for refinery construction that would increase the national crude-topping capacity by almost 1.3 million b/d and catalytic cracking capacity by 922,795 b/d, Deputy Petroleum Administrator J. Ed Warren reported recently.

If and when all PAD-recommended construction is accomplished, total crude topping capacity would rise to 8,104,176 b/d from its Jan. 1, 1952, figure of 6,811,684 b/d. Catalytic cracking capacity rise would be to 2,856,225 from 1,933,430. Table 1 shows a detailed tabulation of certificates of accelerated tax amortization recommended by PAD on crude topping and catalytic cracking through April. Parent companies rather than individual subsidiaries are listed for the large and intermediate refiners. Classifications are as follows: large refiners—those refining 50,000 b/d or more; intermediate—between 20,000 and 49,999; small—less than 20,000 b/d.

The relative share of modern refining facilities owned by smaller refiners will be markedly increased if the approved program is realized, the Deputy PAD's report showed. As of Jan. 1, 1952, small refiners had 9.86% of total crude capacity and only 1.86% of catalytic cracking capacity. Construction of all the facilities recommended by PAD for tax write-off would increase these percentages to 10.87 and 6.54.

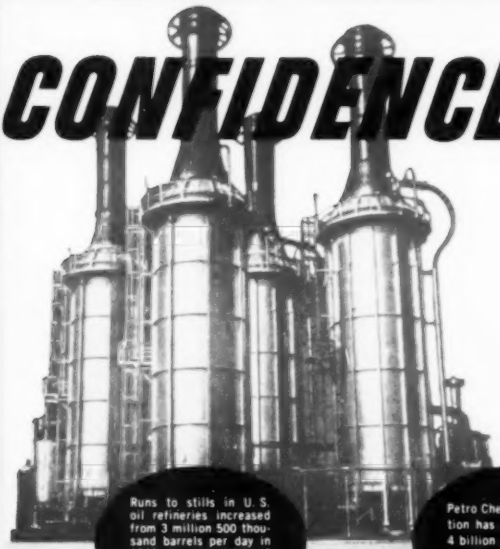
"The increase in cat-cracking capacity of the smaller refiners, which would be more than four-fold, is especially significant," Mr. Warren commented. "Cat crackers represent the most modern facilities in refining today. They permit the more efficient processing of crude and so permit production of higher grades and bigger yields of gasoline without so great dependence on tetraethyl lead to raise octane ratings. A refinery with a catalytic cracker is obviously in a better competitive position than one without a cracker—and the small refineries are getting themselves into that position."

On Jan. 1, 1952, the large refiners had 81.52% of crude capacity and 91.21% of catalytic cracking capacity. If the approved construction is completed, these will decline to 80.1 and 86.17% respectively. Changes for the intermediate refiners would be from 8.62 to 9.63% on crude and from 6.93 to 7.29% on cat cracking.

Very few new certificates of accelerated tax amortization were recommended by PAD during May because the confusion of the petroleum strikes did not leave time for processing applications, Mr. Warren said. Since the strikes' end, however, the agency has resumed processing in an effort to assure realization of the DPA-approved expansion program, which calls for starts on construction to add to refining capacity at the rate of 500,000 b/d for the last half of 1952 and all of 1953.

Table 1—Certificates of Accelerated Tax Amortization Recommended by PAD Through April 1952

	Capacity Expansion, b/d	
	Crude Oil Topping	Cat Cracking
LARGE REFINERS		
Standard Oil Company (New Jersey)	105,605	102,200
Standard Oil Company (Indiana)	65,000	60,000
Socony-Vacuum Oil Co., Inc.	47,000	33,000
The Texas Company	54,000	5,600
Gulf Oil Corporation	93,740	107,000
Standard Oil Company of California	54,700	37,500
Sinclair Refining Company	62,000	58,000
Shell Oil Company	80,000	52,000
Cities Service Oil Company	52,450	20,820
Phillips Petroleum Company	68,445	47,200
Sun Oil Company	11,000	.....
Tide Water Associated Oil Co.	4,000	.....
Atlantic Refining Company	60,000	31,500
Union Oil Company of California	27,000	28,500
The Pure Oil Company	12,100	28,000
Standard Oil Company (Ohio)	76,500	27,400
Continental Oil Company	28,500	17,000
Ashland Oil & Refining Company	26,500	21,100
Richfield Oil Corporation	7,725	21,000
Total large refiners	936,260	697,820
INTERMEDIATE REFINERS		
Apollo Gasoline Company	16,000	7,000
The Bay Petroleum Corporation	2,000	8,000
Cooperative Refinery Association	3,500	3,400
Crown Central Petroleum Corporation	2,350	2,400
Globe Oil & Refining Company	10,000	5,500
Lion Oil Company	5,000	10,000
Ohio Oil Company	10,000	5,000
Pelto Corporation	4,300	10,000
Republic Oil Refining Company	30,000	.....
Southwestern Oil & Refining Company	15,500	5,000
Sunray Oil Corporation	25,000	9,000
Taylor Refining Company	20,500	8,000
Texas City Refining Company, Inc.	.....	8,000
Totals intermediate refiners	144,250	74,300
SMALL REFINERS		
American Liberty Oil Co., Mt. Pleasant, Texas	5,000	5,000
Ref. Oil & Gas Co., Ben Franklin subsidiary, Ardmore, Oklahoma	.....	5,000
Ben Hur Ref., Long Beach, California	6,800	6,000
Caminol Co., Hanford, California	1,500	.....
Cosden Petroleum Corp., Big Springs, Texas	4,000	.....
Derby Oil Co., Wichita, Kansas	5,000	8,000
Douglas Oil Co., Bakersfield, California	1,800	.....
El Dorado Refining Co., El Dorado, Kansas	3,450	5,000
Elk Refining Co., Falling Rock, West Virginia	1,470	.....
Famariss Oil & Ref. Co., Hobbs, New Mexico	5,000	.....
Farmers Union Central Exchange, Laurel, Mont.	3,140	5,000
Fletcher Oil Co., Wilmington, California	1,356	.....
Fulton & Olmstead, San Antonio, Texas	10,000	4,650
Gilcrease Oil Co., Metaux, Louisiana	6,000	3,000
Hancock Oil Co. of Calif., Long Beach, Calif.	16,066	12,000
Inland Refining Co., Palestine, Texas	.....	700
Johnson Oil Supply Co., Gary, Indiana	2,500	1,500
Kanotex Ref. Co., Arkansas City, Kansas	5,050	5,000
Lakeside Ref. Co., Kalamazoo, Michigan	2,000	.....
Leonard Refineries, Inc., Alma, Michigan	10,000	3,000
Levelland Ref. Co., Levelland, Texas	.....	3,000
Louisville Ref. Co., Louisville, Kentucky	.....	6,000
M.F.A. Oil Co., Memphis, Tennessee	2,000	2,000
McMurrey Pet. Corp., Tyler, Texas	3,000	4,000
Mercury Oil Ref. Co., Oklahoma City, Okla.	5,000	3,000
Mid-West Refineries, Inc., Alma, Michigan	6,200	.....
Mohawk Pet. Corp., Bakersfield, California	8,000	6,800
Monarch Ref. Co., San Antonio, Texas	.....	5,000
New Mexico Asphalt & Ref. Co., Artesia, N. M.	3,000	6,000
Northwestern Ref. Co., St. Paul Park, Minnesota	25,000	3,000
Old Dutch Ref. Co., Muskegon, Michigan	8,000	7,000
Panhandle Producing & Refining Co., Wichita Falls, Texas	3,250	.....
Petroleum Specialties, Flat Rock, Michigan	1,500	.....
Pontiac Ref. Corp., Corpus Christi, Texas	.....	5,000
Premier Petroleum Co., Ft. Worth, Texas	6,000	4,000
Rado Refining Co., McAllen, Texas	1,500	.....
Rado Refining Co., Harlingen, Texas	4,000	3,025
Rothschild Oil Co., Santa Fe Springs, California	.....	6,000
The Shamrock Oil & Gas Corp., Sunray, Texas	2,500	6,000
Superior Refinery Owners, Superior, Wisconsin	6,000	1,000
Vickers Petroleum Co., Potwin, Kansas	5,000	4,000
Western Oil & Fuel Co., Superior, Minnesota	10,000	3,000
Western States Ref. Co., North Salt Lake, Utah	3,000	2,000
Wood River Oil & Ref. Co., Gary, Indiana	15,000	7,000
Total small refiners	208,982	150,675
Grand total all companies	1,289,492	922,795



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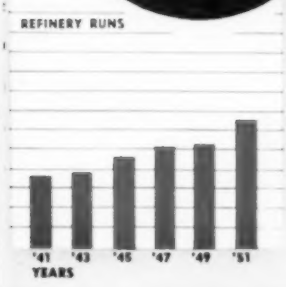

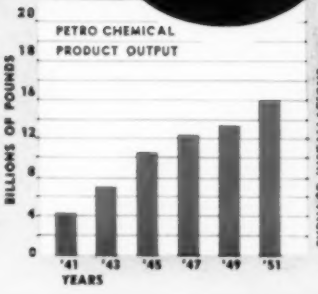

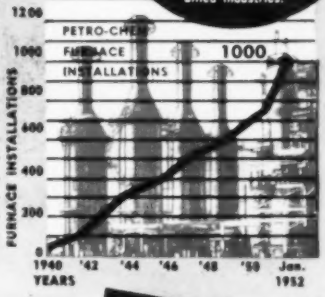

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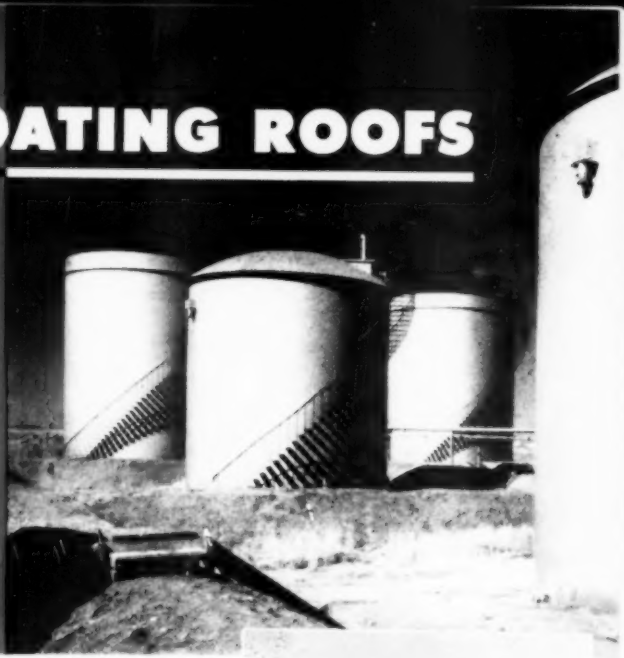

The Horton tanks in the upper right hand corner of this page are located at Celanese Corporation of America's petrochemical plant in Bishop, Texas. They are all equipped with Horton Double Deck Floating Roofs which ride directly on the liquid in the tanks. Two of the tanks also have umbrella roofs to eliminate the possibility of a slight amount of rain water entering the tanks through the floating roof seals.

Celanese Corporation built its Bishop, Texas plant to utilize natural gas, butane and other petroleum derivatives in making various petro-chemicals such as acetone. Natural gas is also used as fuel to operate the plant.

Chicago Bridge & Iron Company offers the petro-chemical industry a complete service in steel plate work . . . designing, fabricating and erecting. Write our nearest office for quotations.

Top: Two 2,000 bbl. and two 4,000 bbl. tanks with Horton Floating Roofs. The 2,000 bbl. tanks also have umbrella "weather" roofs. All four tanks are used to store acetone.

Center: Close-up view of the two 4,000 bbl. tanks with Horton Floating Roofs used to store acetone.

Left: Two cylindrical tanks with hemispherical ends used to store butane at Celanese Corporation of America's Bishop, Texas plant.

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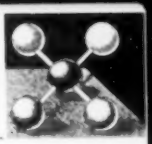


Petroleum Plays a Growing Role In Manufacture of Aromatics

- **BENZENE**—Production from petroleum of 100,000,000 gals. annually by 1953 will balance supply and demand
- **TOLUENE**—More than enough potentially available from catalytic reforming to meet all chemical needs
- **XYLENE**—Outlook promising for new uses as chemical intermediates
- **NAPHTHALENE**—Refiners can supply o-xylene to make phthalic anhydride (its principal derivative) if coal tar supplies fail to loosen up

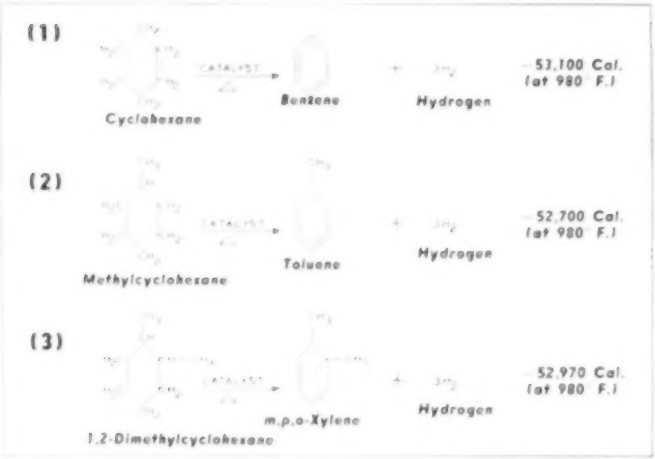
By H. E. BRAMSTON-COOK
Oronite Chemical Co.
New York, N. Y.

THE early history of the aromatic hydrocarbon chemicals industry in the U. S. dates back before the first World War when aromatics such as benzene, toluene, and xylene were recovered as by-products of the coal tar industry and the principal field of consumption was in the manufacture of dyes for the textile industry. As early as 1900, some crude naphthalene was recovered from crude coal tar.

However, it was not until the outbreak of that war, when our supplies of dyestuff and fine organic chemicals from Germany were cut off, that the U. S. began to produce sizeable quantities of aromatics. From 1915 to 1918, the production of coal tar light oil, from which aromatics are recovered, increased from 20,000,000 to 65,000,000 gals. per year. However, even this enormous expansion could not satisfy the demand for toluene required for the explosive trinitrotoluene. In addition to stripping toluene from illuminating gas, commercial production of toluene from petroleum by the thermal decomposition of the non-aromatic components of toluene-containing virgin naphthas was undertaken.

After the first World War, the production of toluene, which had been used almost exclusively for TNT manufacture, dropped almost to nothing and since production from petroleum proved to be uneconomic compared with coal tar toluene, the practice was discontinued.

In the period between wars, the aromatic hydrocarbon chemical industry reverted to coal tar as the principal raw material and no significant commercial production of pure aromatics from petroleum appeared. The increase in demand featured a steady growth which essentially disregarded changes in the business cycle and continued throughout the years up to the second World War. In all this period, there was never a real shortage of the major refined products from coal tar sources due to the fact that from 5,000,000 to 15,000,000 gals. per year of aromatic hydrocarbon concentrates were supplied by the petroleum industry. These concentrates were made mostly by solvent extraction, although one plant did use the so-called hydrogenation process. The basic aromatic hydrocarbons, benzene, toluene, xylene, and naphthalene were generally in ample supply up until the second war. As late as 1940, only about 40,000,000 gals. of refined benzene were recovered from an estimated potential from coal tar of 135,000,000 gals., with the remainder utilized in a partially refined state to mix with gasoline for use as a motor fuel. Toluene production, with a potential supply of around 35,000,000 gals. from coal tar reached only 20,000,000 gals. by 1939 and was used principally as a solvent rather than for chemical manufacture. Xylene production reached only 5,000,000 gals. by 1940, all from coal tar, and was used as a solvent and in gasoline blends. Naphthalene production, with a potential of around 350,000,000 lbs. per year reached only



PRINCIPAL REACTIONS for producing aromatics by Hydroforming

about 1870,000,000 lbs. in 1940.

Before the second World War, therefore, there was little incentive or need for the commercial production of these aromatics from petroleum since abundant supplies at a relatively low price were available from the coal tar chemical industry. However, a great deal of development work on aromatics from petroleum was carried out in the U. S. during those 20 years of comparative peace of greatest importance was the discovery and development of the hydroforming process, which was developed primarily for the improvement of octane in motor fuels.

At the start of World War II, the demand for toluene for use in TNT again greatly exceeded the supply available from coke-oven sources, and the Hydroforming process was immediately projected into plants to produce toluene. Since the Hydroforming process is basic to the petroleum industry's current position as an important supplier of aromatic chemicals, a rather detailed description of this process is pertinent to this discussion.

The Hydroforming process consists of the high temperature and pressure catalytic treatment of naphthas in the presence of hydrogen to dehydrogenate cyclohexane, methyl cyclohexane, dimethyl cyclohexane, etc. to the corresponding benzene derivatives. Depending upon the composition of naphtha cut, benzene, toluene, or xylene can be produced according to the principal reactions shown in Fig. 1.

Although these reactions represent the principal mechanism for aromatics formation by Hydroforming, a number of side reactions also are stated to take place as follows:

(1) Aromatization of paraffins for example, conversion of normal heptane to toluene.

(2) Isomerization of naphthenes or paraffins.

(3) Various thermal decompositions.

(4) Alkylation and condensation reactions to form small quantities of high boiling material.

(5) Decomposition of sulfur-containing compounds.

(6) Hydrogenation of olefins.

Hydroforming is a cyclic operation requiring periodic regeneration of the catalyst by oxidation to remove the carbon produced in the reaction and deposited on the catalyst as coke and to balance heat requirement. The cyclic nature of Hydroforming is a definite limitation of the process compared to the new catalytic reforming processes developed since the war.

Since the main reaction is highly endothermic, two or more reactors are generally used in series in order to introduce the required amount of heat at the proper temperature level. Although the reaction can be carried out at from 3 to 25 atmospheres, the usual operating pressure is about 15 atmospheres, and the partial pressure of hydrogen from 40 to 90%. The usual temperature range is 900-1000° F.

Although all of the hydrogen is obtained from the gases liberated in the process, it is important to note that Hydroforming represents a dehydrogenation process in the presence of excess hydrogen over that produced in the dehydrogenation reaction. This excess is provided by a recycle of the hydrogen-rich light gas (about 70% H_2) produced in the process.

Although, as mentioned above, the Hydroforming process was developed primarily to improve octane, it can readily be seen that by careful selection of feedstock and minor changes in operating conditions, this process can be directed toward the production of benzene, toluene, or xylene. Since toluene was a critical product during the second war, ten Hydroforming plants were built to produce toluene. The steps involved in the production of toluene by Hydroforming were generally about as follows:

(1) Preparation of a 200-250° F. boiling range naphtha from a highly naphthenic crude. This cut should contain the maximum content of methyl cyclohexane and toluene. In actual practice, the crude naphtha cut points at the primary distillation units were usually adjusted for the recovery of about 90-95% of the methyl cyclohexane in the crude.

(2) Hydroforming this cut to give maximum toluene yield. For the maximum production of toluene, the Hydroformer is operated at 10 atmospheres and about 950° F. From a highly naphthenic 200-250° F. virgin naphtha which contained 33.6 vol. % methyl cyclohexane and 0% toluene, yields of 28 vol. % based on feed were realized during the war.

(3) Preparation of a heart cut from this "hydroformate" after preliminary stabilization. This is accomplished by distillation in two columns. If, in addition to the "heart cut", a normal heptane stream is produced, three columns are used. In some operations an additional 200° F. end point light aviation cut is also produced requiring a fourth column. The heavy aromatic product is usually rerun to recover xylenes.

(4) The isolation of pure toluene from this "heart cut". This concentration can be accomplished in a number of ways, such as the azeotropic distillation with methyl ethyl ketone, water azeotrope, solvent extraction with liquid sulfur dioxide, or phenol extractive distillation. Extraction of toluene with liquid sulfur dioxide results in an extract phase containing 65-70% aromatics. Additional purification of this extract is needed for nitration grade toluene.

In addition to that supplied by the Hydroforming process, appreciable quantities of toluene were produced by the Shell Oil Co. with their own two-stage process. In the first stage, dimethyl cyclopentane was catalytically isomerized to methyl cyclohexane, thereby increasing the volume of material susceptible to dehydrogenation. In the second stage the isomerization product, plus additional methyl cyclohexane, was catalytically dehydrogenated to toluene.

The Hydroforming process also enabled the petroleum industry to provide the large quantities of xylenes required for octane improvement of

aviation gasoline during the second war. In 1945 some 46,000,000 gals. of xylenes were reported as produced from petroleum (vs. 10,000,000 from coal tar), even though the major portion of the xylenes produced were consumed as a constituent of gasoline and would not show up in the statistics.

As mentioned above, xylenes are also produced when operating the Hydroformer for maximum toluene production. However, by selection of a narrow cut of C_8 naphthenes as feedstock, the Hydroformer can be operated to produce primarily o-, m-, and p-xylenes and ethyl benzene. For this operation a virgin naphtha fraction with a boiling range of 230-260° F. is charged to the Hydroformer at 900-1000° F. under pressures ranging from 3 to 25 atmospheres. The product contains a mixture of ethyl benzene and the three xylenes at relatively high concentrations.

Although benzene requirements during the second war increased rapidly (from 110,000,000 gals. in 1940 to 210,000,000 gals. in 1944), due chiefly to increased demand for phenol and styrene for synthetic rubber, the supply did not become as critical as in the case of toluene. For this reason, and also because of the high cost of synthetic benzene, the commercial development of benzene from petroleum (i.e., from the Hydroformers) did not approach that of toluene.

Naphthalene production, all from coal tar sources, was approximately doubled from 1940 to 1943 in order to supply the increased demands for the manufacture of phthalic anhydride and beta-naphthol.

Summarizing developments during the second war, this period saw the first large scale production of toluene and xylene from petroleum but no significant production of benzene or naphthalene from petroleum.

With the end of hostilities, the Hydroforming plants reverted to their expected peacetime function of supplying gasoline. As would be expected, the demand for toluene dropped sharply, relieving the need for Hydroformers in this use. Benzene demand, however, continued to rise as deferred peacetime demand more than made up for the drop in use in synthetic rubber. The rapid growth of the plastics industry requiring increased quantities of phenol and polystyrene, plus the phenomenal growth of the synthetic detergent industry, soon brought about a shortage of benzene even though steel operations continued throughout the post war period at an unusually high level. The extent of this shortage, which has been increased by the demands of the mobilization economy, is illustrated by the forecasted requirements, estimated by representatives of the benzene consuming industries in the U. S. and shown below. These estimates, which have been made for both a mobilization and "normal" economy, are in millions of gallons.

	Mobilization	Normal
1951	252	222
1952	307	243
1953	358	262
1954	376	278
1955	411	291

Since the current coke oven benzene production rate of 180,000,000 gals. per year is close to the estimated maximum potential of 190,000,000 gals.; and the imports of 55-60,000,000 gals. per year are considered the maximum available, it is apparent that a new source of supply petroleum is needed to meet the incremental demands.

At present benzene is being derived from petroleum by adaptations of the processes which were used during the second war for toluene manufacture and in the post war period for upgrading aviation gasoline. Benzene production from these sources during 1951 is estimated to be about 20,000,000 gals. The operation for benzene production using the Hydroforming process is similar to that described earlier for toluene but charging a narrow cut naphthenic fraction containing maximum cyclohexane as feedstock. Similarly, it is reported that Shell is now using their two-stage isomerization and dehydrogenation process, which produced toluene during the second war, for benzene production. In the current operation, methyl cyclopentane derived from natural or straight-run gasoline is catalytically isomerized to cyclohexane in the first stage. The isomerization product plus additional cyclohexanes are then dehydrogenated over a second catalyst to benzene in the second stage.

Recently new catalytic reforming processes which permit the production of aromatics or high octane gasoline at high yields in a continuous operation requiring no regeneration or infrequent regeneration if operated at very severe conditions, have been developed and are assuming the major position in the production of aromatics from petroleum.

One of these processes, called Platforming, has been accepted by many oil companies to meet the need for additional aromatics, especially benzene. Platforming, developed by Universal Oil Products Co., was first used commercially in 1949 for upgrading gasoline. The process uses a catalyst containing platinum and is essentially continuous, since periodic regeneration of the catalyst is not necessary. An important advantage of the Platforming process is that it has been found suitable for the conversion of C_6 ring naphthenes, by isomerization, as well as C_5 ring naphthenes, to benzene. Moreover, during the formation of benzene, the paraffinic constituents undergo isomerization. The high extent of branching in the product makes the residual paraffinic material valuable from a motor fuel standpoint. The comparative ease with which the process can be switched to either aromatics or motor fuels by modification of feedstock and operating conditions is also an important factor in the economics of the process.

The production of benzene by Platforming is accomplished by charging a fraction, from a highly naphthenic crude, containing large percentages of methyl cyclopentane and cyclohexane. The feed is passed through reactors, usually four in series, filled with a supported platinum-base cata-

Meet the Author

H. E. Bramston-Cook knows whereof he speaks when he discusses the subject of aromatics from petroleum. He has had approximately 25 years of specialized experience in the petroleum field, and was responsible for the major pre-war development in supplying petroleum aromatic solvents from west coast crudes for nation-wide industrial consumption.

His present position is that of vice president of Oronite Chemical Co., a subsidiary of Standard Oil Co. of California.

Born in England, Mr. Bramston-Cook was brought to the Canadian Northwest Territory by his family in 1903. He received his master's degree in chemical engineering from the University of British Columbia, and in 1927 joined Union Oil Co., where he was later manager of technical products sales.

He has served in both World Wars. He was in the Canadian Army in World War I when only 15 years old, and was a pilot officer in the Royal Air Force when discharged.

lyst in the form of ⅛ in. pellets. The principal reaction is dehydrogenation, and the yield of benzene from C_6 naphthenes in a single pass is 80% of the theoretical and may be increased by recycling. Natural benzene present in the feed (normally 1.9% in a typical 140-185° F. fraction) passes through the reactors unchanged. Reactor temperatures of about 900° F. and pressures around 250 psi are maintained. Following the dehydrogenation section, the aromatic rich stream is charged to a stabilizer, then to a separator to remove paraffins, and finally to the fractionation section to recover benzene, toluene and xylene. The paraffins removed in the separator have been isomerized under the conditions used for benzene production and are therefore important constituents of high octane motor fuel.

At the present time there are a total of 21 Platformers either in operation, under construction, or in the planning stage.* However, of these only six are being designed and constructed to recover aromatics for chemical use. When in operation in mid 1953, these plants alone will produce about 55,000,000 gallons per year of benzene. However, in evaluating the potential supply situation regarding benzene or toluene and xylene, too, the flexibility of the Platforming process must be recognized. This flexibility makes all 21 Platformers potential aromatics producers.

Although the majority of new production of benzene and other aromatics from petroleum will utilize the Platforming process, at least two other processes, aside from hydroforming, will also be used. These processes are also based on catalytic reforming of naphthene fractions. One of these, developed by Atlantic Refining Co., is similar to Platforming and uses a new platinum catalyst developed by Atlantic and manufactured by Davison Chemical Co. Atlantic has announced plans to construct a plant at Philadelphia to produce 7,000,000 gallons a year of benzene.

Another process recently announced is Houdriforming, developed by Houdry Process Corp. This is a continuous catalytic reforming process which reportedly produces good yields of benzene, toluene or xylenes from close cut naphtha fractions. It is claimed that conversions of naphthenes to aromatics up to 95% of equilibrium are obtained with this process. A Houdriformer is being constructed by the Sun Oil Co. to produce 15,000,000 gallons per year of benzene.

Although not specifically designed for benzene production, the three new units planned by Socony-Vacuum Oil Co., Inc., using their own TCR (Thermofor Catalytic Reforming) process are also potential producers of benzene.

A tally of the expected production of benzene from petroleum by all methods indicates that about 100,000,000 gallons per year will be available from this source by the end of 1953. Assuming that coke oven benzene will operate near its estimated capacity of 190,000,000 gallons per year and imports will continue at the high rate of about 55,000,000 gallons, the additional benzene from petroleum will give a total supply rate of around 345,000,000 gallons by the end of 1953. Since mobilization requirements for the entire year 1953 are estimated at 338,000,000 gallons, there would appear to be a reasonably close balance between supply and demand for that year provided there are no serious construction delays in the new benzene plants.

The demand for toluene in the U. S. is closely related to the defense effort, particularly TNT and aviation fuel. Relatively little progress has been made in the development of chemical derivatives of toluene. A possible exception is the use of vinyl toluene as a substitute for styrene both in synthetic rubber and in paints and varnishes. Although experimental commercial manufacture of synthetic rubber based on vinyl toluene has been started by the Goodyear Rubber Co. and is reported to be satisfactory, the requirements for toluene are expected to be small compared with the enormous quantities potentially recoverable from these new catalytic reforming units and hydrotormers. It is expected that most of the toluene produced will continue to be used for blending into aviation fuels.

Although a large part of the increased quantities of C_8 aromatics available from these new plants will, like toluene, be consumed in gasoline blends, the outlook for increased consumption of the xylenes as chemical intermediates is considerably more promising than in the case of toluene. Phthalic anhydride, which was once produced exclusively from naphthalene, has also been derived commercially by the oxidation of ortho xylene since 1945. The separation of the ortho isomer from the mixed xylene to obtain the raw material for phthalic anhydride manufacture also gives increased value to the meta-para mixture in aviation gasoline blends, since the ortho isomer is detrimental in this use.

A rapidly expanding use for para-xylene is in the manufacture of terephthalic acid, which is used for the new polyester fiber Dacron and a new transparent base for film (Mylar). The meta isomer is of importance as an aviation gasoline component, and although its commercial use as a chemical intermediate is limited currently to dyestuff and musk intermediates, development work indicates that its production cost can be lowered for use in the manufacture of isophthalic acid—a promising new compound for alkyd and polyester resins and plasticizers. In view of the rapid progress already made and the attractive possibilities now in the process of development for the use of individual xylene isomers as chemical intermediates, together with the established uses of xylol as a solvent and in gasoline blends, it is anticipated that the increased volumes of xylenes made available from the new aromatics plants will be readily absorbed by the markets.

While they are not present in substantial proportion in coke by-product fractions, alkyl benzenes higher than the xylenes are found in hydroformer and Platformer streams in substantial quantities: *Pseudocumene* (1, 2, 4-trimethyl), *mesitylene* (1, 3, 5-trimethyl), *durene* (1, 2, 4, 5-tetramethyl) and *iso-durene* (1, 2, 3, 5-tetramethyl) are the principal products of interest in this connection. None of these is currently manufactured commercially from catalytic reformer streams. However, it is probably safe to say that the basic technology for the commercial recovery of these compounds has been worked out and that in due time their manufacture on substantial scale will develop.

Naphthalene has been in short supply for some time. However, according to Government reports, recently issued, the shortage of this commodity is expected to be relieved by about 1954 through improvements in existing recovery operations and expanded coking and by-product recovery capacity. Even so, the petroleum industry stands ready to provide o-xylene as a functional substitute for naphthalene in the manufacture of its principal derivative, phthalic anhydride.

In summary, it is apparent that the petroleum industry is rapidly assuming a dominant position in the manufacture of benzene and its homologues. The nation and the chemical and petroleum industries can be proud of the speed and smoothness with which the threatened major shortages of these all important materials have been overcome.

*Since this paper was prepared the total number of Platformers in the U. S. has increased to 26 as of July 21—16 for motor fuel (6 in operation and 4 building), and 10 for aromatics (3 in operation and 7 building). Design charge capacity of the motor fuel units is 39,141 B/D, while that of the aromatics units is 9,150 B/D.

This paper was originally presented before the New York Section, American Institute of Chemical Engineers, March 20, 1952, under the title "Changes in Aromatic Hydrocarbon Sources," and is being published in the August, 1952 issue of the Society's *Chemical Engineering Progress*.

Solubility Factors Enhance Uses of Petroleum Sulfonates

TECHNOLOGICAL progress in the manufacture of oil-soluble petroleum sulfonates has been advanced through the development of an oil-free sulfonate by L. Sonneborn Sons, Inc., New York. Petroleum sulfonates represent one of the most important types of surface-active agents available to industry, and the oil-soluble type are finding growing use in many industries as lube oil additives, emulsifiers, corrosion inhibitors, and soluble cutting oils, among other purposes. Table 1 illustrates the wide diversification in the application of the oil-soluble sulfonates.

The early demand for petroleum sulfonates was met by recovering them as by-products from the sulfuric acid treatment employed in refining white oil. Growing usage over the last ten years, however, has taken them out of the by-product class and they are produced today as primary chemical products.

Research work of Sonneborn and other sulfonate manufacturers, according to Dr. Erich Meyer, director of technical research at Sonneborn, has been directed toward the development of specialized products for specific uses of industry. Typical of such specialized products are the oil-soluble and yet oil-free petroleum sulfonates. These materials, it is claimed, will be of particular interest to the plastic and synthetic rubber industries, because they can be applied as emulsifiers in the emulsion polymerization of synthetic resins and synthetic rubber latices, primarily for the emulsion polymerization of butadiene with either styrene, acrylonitrile or vinyl compounds. In the past the oil content of conventional type sulfonates has been found detrimental in these and similar applications.

Petroleum sulfonates are classified as sodium salts of an alkyl aryl petroleum sulfonic acid with a sulfonate radical firmly anchored to the aryl group. While the actual structural formula for petroleum sulfonates is not as yet known, they may be defined by the generic formula $C_nH_{...}SO_3Na$.

In the refining process, both water- and oil-soluble petroleum sulfonates are produced. The water-soluble sulfonates contain less than 22 carbon atoms, whereas the predominantly oil-soluble sulfonates contain more than 22 carbon atoms. An oil-soluble petroleum sulfonate has a molecular weight of about 415 or greater, whereas a typically water-soluble petroleum sulfonate has a molecular weight of less than 400.

Thirty years ago when purified petroleum sulfonates were first developed, relatively few uses for them were known. However, during the decade preceding World War II, systematic research into their functional properties was instituted. As a result, their important characteristics as effluent surface active agents were recognized. Thus, petroleum sulfonates became one of the first important petrochemicals obtained from petroleum through chemical reaction.

One of the first important industrial uses for petroleum sulfonates was in fat splitting. During the 1930's they found important application as emulsifying agents in the manufacture of water miscible or "soluble" petroleum oils used in the metal cutting industry, textile industry and by all those industries which needed effective agents for emulsifying petroleum oils.

Rust and Corrosion Inhibitors

Further study reveals another important characteristic of the petroleum sulfonates, namely their function as primary rust and corrosion inhibitors when blended with petroleum oils. These properties are undoubtedly due to their ability to form stable, colloidal, water-in-oil dispersions which act as a moisture barrier, absorbing the moisture before it can attack the metal.

As a result, petroleum sulfonates were increasingly used in the manufacture of rust preventive compounds and in many applications where protection of metal against rust and corrosion was needed.

At about the same time the problem of cleanliness in high speed diesel engines became critically important to the users of such equipment. While the problem was primarily one concerning the quality of fuel oil, it was found that the presence of a detergent in the crank-case lubricating oil could have a pronounced beneficial effect. While various chemical compounds were tried out for their efficiency as lubricating oil detergents, the pendulum swung finally in the direction of some of the alkaline earth petroleum sulfonates. The use of such compounds had reached a high state of development by 1941.

However, no one in the industry had anticipated the tremendous importance that petroleum sulfonates acquired during the last World War. It can be stated that they contributed in no small measure to the efficiency of the Allies' war machinery.

Aided by the countless new developments and uses, consumption of sulfonates after the war, instead of falling off, showed a healthy growth. In order to take care of this steadily increasing demand, manufacturers have substantially increased their facilities with the result that today production of petroleum sulfonates is not only in balance with the demands of industry but is able to take care of our expanding economy as well as the increased needs of the national defense program. Furthermore, in line with greater manufacturing efficiency and increased production of petroleum sulfonates, there has already been noted a tendency toward lower prices.

The extensive use of the oil-soluble petroleum sulfonates in industry is due to the following four major functional properties: 1) Emulsification and dispersion of liquids, 2) Dispersion and wetting of solids, 3) Wetting and dispersion of liquid-solid systems, and 4) Inhibition of rust and corrosion.

It has sometimes been stated that, since petroleum sulfonates are obtained by acid treatment of petroleum hydrocarbons, they are mixtures of varying makeup and thus users must change their formulations to suit the sulfonate raw material. Nothing could be further from the truth. Today, manufacturers of petroleum sulfonates, who have acquired their skill and know-how over many years of manufacturing experience, supply industry with products that are tailored to fit the individual use.

Table 1—Some Applications for Oil-Soluble Petroleum Sulfonates

- Agricultural Spray Oils
- Alcohol Anti-Freeze
- Asphalt Paving and Roofing Adherent
- Cordage Oils
- Crude Oil Emulsion Splitting
- Cutting Oils
- Dry Cleaning Soaps
- Emulsion Polishes
- Fat Splitting
- Fuel Oil Sludge Dispersants
- Insecticide Formulations
- Leather Finishing
- Lube Oil Addition Agents
- Ore Flotation Processes
- Pigment Dispersing
- Plastic Dispersions
- Rubber Dispersions
- Rust Preventive Compounds
- Solvent Cleaners and Degreasers Emulsifiable
- Textile Oils

SILICA GEL ADSORPTION FOR

Separation of Liquid Hydrocarbons

By E. K. SEYBERT
Technical Service Division
Davison Chemical Corp.

SEPARATING a liquid mixture into individual members is a problem common to the petroleum and chemical industries. Distillation accomplishes many such separations by taking advantage of the differing boiling points of the components. Similarly, a difference in freezing points of the compounds in a liquid can assist in accomplishing fractional separation.

For many years, the use of physical adsorbents such as silica gel has been known as a means of separating complex liquids. In 1906 the use of a solid adsorbent was found to effect the sharp separation of a mixture of colored solutes into individual members. Recently rapid development has occurred in the techniques of separation and purification by this method. Terminology applied has ranged from such wording as adsorptive filtration and chromatography to the recent and more apt description "selective adsorption." Regardless of the label, the method accomplishes the desired separation through difference in "adsorbability."

The elements of the selective separation process are relatively simple. When a mixture, such as two hydrocarbons, is poured through a column of silica gel, one of the hydrocarbons is held more tightly than the other compound. This difference in adsorbability is due to molecular size, weight, and arrangement, heat of wetting, polarity, and solubility factors. The more strongly adsorbed member is held at the top of the column, while the more loosely held material is pushed down into the lower section. As sufficient liquid is poured through the column, the more strongly adsorbed material "pushes" the more loosely held material through the adsorbent column. If the strongly adsorbed member is to be collected, a still more strongly adsorbed liquid can be added to the column. This action is literally a chasing of molecules down the column, each molecule displacing another type more loosely held. By taking the discharge or effluent from the bottom of the column in small increments, a very closely controlled separation of the originally charged feed-stock is possible. After regeneration of the silica gel, the column is ready for another separation cycle.

Because of the special requirements of petroleum and chemical manufacturing, selective adsorption as a unit process has found increasing emphasis in these fields. The development of specific silica gels for liquid phase separation on laboratory and pilot plant scale, and development of economic methods of regenerating the silica gel, have shown the practicality of using silica gel adsorption for separating hydrocarbon liquids on commercial scale.

Of the many factors affecting a selective separation operation, choice of the proper adsorbent is all important. The adsorbent with its inherent characteristics such as particle size, pore volume, surface area, and specificity of adsorption, affects all other variable factors in the process. Until the last decade, many naturally occurring adsorbents were used for selective separation studies. The practically uncontrollable variations of purity, pore size, and other characteristics of these adsorbents adversely affected reliability of results in several studies.

Of the many adsorbents available for selective separation, silica gels, aluminas, charcoals, starches, magnesium silicates, and ion exchange compounds have been widely employed. Not all are specific for each particular separation, and in many instances the characteristics of the adsorbent are non-uniform from batch to batch. This is especially true where the laboratory investigator attempts to prepare the adsorbent with his own facilities. Some of the commercial products being of natural origin are so variable in characteristics from lot to lot that the individual user must exert caution in selecting the most reliable material. Synthetic products such as silica gel can be and are manufactured under rigid controls to ensure uniformity of chemical and physical properties.

Particle size distribution is important in controlling solute flow, sharpness of separation, sizing of bed or column, and especially in commercial processing, the cost of operation. For column work on the laboratory separation of petroleum fractions, a through 200 mesh silica gel was found most satisfactory for precision work by the National Bureau of Standards (ASTM Designation: D936-47T). However, recent work indicates a larger particle size, e.g. 60 to 200 mesh, may in some instances be used to achieve the same sharp separation with increased percolation rates.

For much of the current steroid separation work in the medicinal-pharmaceutical field, both on laboratory and pilot plant scale, the 60 to 200 mesh high purity silica gel has been found most satisfactory. The separation work in this field was initially found satisfactory using a more finely divided through 200 mesh product, however, the percolation rate was too slow. For batch operations wherein a slurry of the parent liquid and adsorbent is separated on a vacuum filter, a through 325 mesh particle size has been most frequently used. In this latter instance, slight difficulty sometimes occurs with relatively hard caking of the adsorbent on the filter cloth. This indicates the possibility of using larger particle size, either 100 to 200 mesh or 28 to 200 mesh, in this type of operation.

For large scale operations involving gallons rather than cubic centimeters of liquid to be percolated through the adsorbent, either a 28 to 200 mesh or 28 to 80 mesh have been found most suitable. The large particle size permits higher percolation rates, but each problem in separation must determine the optimum material with regard to efficiency of separation and maximum percolation rate.

Activated carbons are available in a variety of particle sizes ranging

Meet the Author

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from a large 4 to 6 mesh to a relatively fine sized through 200 mesh. In a number of adsorption applications a finely powdered carbon has been used. Similarly, activated alumina is furnished in a wide range of particle size distribution. For laboratory investigations the smaller particle sizes are preferred, while the larger granular material has been employed for pilot plant operations.

Percolation rate is primarily dependent upon particle size of the adsorbent although viscosity of the liquid in isolated cases can be a factor. For laboratory and pilot scale work, the percolation rate cannot be definitely fixed for each operation; however, several investigations have indicated the optimum flow rates for silica gel, shown in Table 1.

Obviously, these percolation rates would not necessarily effect the same degree of separation on varying length tubes and for investigative work, the optimum column length must be determined for the effective separation desired.

Pore Size Is Important

Of significant import is the average pore size of the adsorbent employed. In some cases, the average pore may be too small to permit significant adsorption of a large molecule. Silica gel can be controlled over a substantial range of average pore diameter—15 Angstrom to 100+ Angstrom units. Porosity figures available indicate that a typical charcoal will have 50-70% porosity on a volume basis, while activated alumina has been cited as having about 25 to 33% average pore volume. Most silica gels on the same basis will have an average porosity of 50-65%, although by controlling gel manufacture higher values are obtained.

Closely related to pore size is surface area. In general, the silica gels used most frequently for hydrocarbon separations average 800 sq. m. of surface per gram although gels having surface areas as low as 100 sq. m. per gram can be furnished. Activated carbons vary in surface area generally ranging from about 400 to 2000 sq. m. per gram. For many liquid phase operations, carbons of about 1500 sq. m. per gram have been used. Similarly, activated alumina granular material exhibits a surface area of about 200 sq. m. per gram.

Packed densities are important from economy of operation and sharpness of separation. Silica gels of densities ranging from 0.25 to 1.0 gram/cc. are available. Granular carbons indicate a density range of 0.42 to 0.55 gram/cc. and activated alumina a range of 0.8 to 1.1 gram/cc. The impalpable powders of all three adsorbents are much lighter in density than the figures quoted, since powders tend to include substantial quantities of minute air pockets when packed. In this regard, there are many techniques for the investigator to follow to ensure maximum packed density in the column or bed. One of the easiest techniques involves filling the column as slowly as possible. On laboratory columns, the granular adsorbent should be poured slowly—almost granule after granule. No vibration or tapping of the column is necessary since such action often yields a lower packed density than is otherwise obtainable. Some investigators prefer to slurry the adsorbent and a solvent together for satisfactory packing and introduction to the column.

Table 1—Optimum Percolation Rates for Silica Gel

Mesh	Scale	Liquid	Percolation Rate
Through 200—On 325	Laboratory and pilot plant tubes	Low viscosity hydrocarbons	7—13 mm/min at 5—10 p/sq
100—200	Laboratory	Low viscosity hydrocarbons	6 mm/min gravity flow
28—200	Pilot scale	Low viscosity hydrocarbons	82 mm/min to 125 mm/min gravity flow
14—28	Pilot scale	Low viscosity hydrocarbons	650 mm/min to 1300 mm/min gravity flow

Purity of the adsorbent is most important. Impurities cannot only contaminate the liquids being separated, but can also act catalytically to cause undesired side reactions. Silica gels can be and are carefully guarded against contaminants. They are typically 99.7 + % pure silica (dry basis).

Table 2 lists the more important group of silica gels available for selective adsorption, together with their general characteristics.

For small scale selective adsorption separations, the operation is carried out on a semi-continuous basis using a tubular column. The feed-stock is held either directly in a top reservoir or in a suitable container having direct access to the column. The column is filled carefully and slowly to assure optimum packing. Plugs of glass wool are sometimes used on the top and bottom of the column.

The solutes of the mixture are held on the silica gel in order of adsorbability. In analytical work, a developing solution is sometimes used to increase the resolution of the bands of adsorbed solutes. This developing solution increases the sharpness of separation of the components of the feed-stock. This developing process can be continued until the various constitutents are eluted from the column and collected.

A desorbing liquid (one more strongly adsorbed than any component of the feed-stock) is generally used to flush the fractions from the column. Physical or chemical measurements are made on each fraction or cut to establish the proper fractions to be combined for the desired separation.

Silica Gel Is Polar

Comprehensive studies of liquid separations by solid adsorbents, particularly on a research laboratory basis, have been reported to guide the individual investigator. For example, general rules with regard to anticipated adsorption of groups of compounds can be and have been set forth. Silica gel, being polar in nature, can generally be expected to behave oppositely to nonpolar charcoal for the adsorption of the same molecule. Similar effects can be shown for other polar adsorbents such as alumina, titania, calcium carbonate in contrast to a group including non-polar talc, and graphite. Discussion and prediction of relative extents of adsorption are set forth by H. G. Cassidy, "Adsorption and Chromatography."[21] Guiding rules were presented as follows:

"Greater adsorption to a surface will occur from that system which produces the greater lowering of interfacial tension." Or "a liquid which is highly adsorbed by a solid will show a low interfacial tension against the solid (and a high adhesion tension, or spreading pressure)."

Table 2—Characteristics of Typical Adsorbable Silica Gels

	Grades					
	912	16	923	922	963	70
Apparent Density, lb./cu. ft.	45	45	43	43	35	25
Pore Size (Angstroms)	20	20	20	30	20	100
Surface Area, sq. m./gm.	800	800	800	800	800	275
Color	White	White	White	White	White	White
Mesh Size	28-200	28-80	100-200	Thru 200	Thru 325	
Silica Content (dry basis)	99.7 + %	99.7 + %	99.7 + %	99.7 + %	99.7 + %	99.7 + %

TYPICAL WATER ADSORPTION CAPACITY

10% R.H.	6.0%
20% R.H.	11.0%
40% R.H.	22.0%
60% R.H.	34.0%
80% R.H.	37.0%
100% R.H.	40.0%

The extent of adsorption is usually greater from solvents in which the adsorptive is less soluble." Also "for a given adsorptive the better solvent will make the better eluent."

"The more polar the substance, the more extensive the adsorption at a solid surface, other things being equal." As a corollary, "since relative polarity decreases on an homologous series, extent of adsorption to polar surfaces should increase up the series." Also to be considered: "Since relative polarity increases up the homologous series, extent of adsorption to polar surfaces should increase down the series."

Variations from guiding rules are to be expected and the individual investigator should anticipate that basic research methods will be useful in selecting the best adsorbent, solvents, developers, and eluting solutions.

The National Bureau of Standards, under an American Petroleum Institute Research Project, has provided considerable information on the utilization of silica gel for the selective separation of various mixtures of hydrocarbons. Typical is their separation of aromatic and mono-olefin hydrocarbons in mixtures with paraffins and naphthenes. Using a technique similar to that described previously, the mixture is introduced through a silica gel column. A suitable desorbing liquid, such as ethyl alcohol, is used to elute the fractions. The fractions emerge in order of increasing adsorbability, namely: paraffins plus naphthenes, mono-olefins, and aromatic hydrocarbons. Refractive index measurements are run on product fractions to determine proper "cut" or "blending" points. The method is particularly useful for determining the aromatic content of straight run petroleum distillates.

Fig. 1 shows a typical sharp separation of a three component solution containing 2,2,4-trimethyl pentane, 2,4,4-trimethyl-1-pentene and toluene.

As with most processes taken from a laboratory scale operation to pilot plant or full scale production, selective separation utilizing solid adsorbents raises basic problems. As would be anticipated, increasing column height, decreasing column diameter and particle size of adsorbent together with reduced feed-stock introduction will often account for sharper separations than initially experienced. Many laboratory separations are gradually refined so that very sharp separations occur, and at the conclusion of each run, it is common practice to discard the adsorbent without regard to possible regenerations.

From a production viewpoint, several of these changes to obtain sharper separations are not economically desirable. Primarily, the laboratory changes have in effect reduced product rate. Similarly, discarding of the adsorbent after one separation is incompatible with economical production methods.

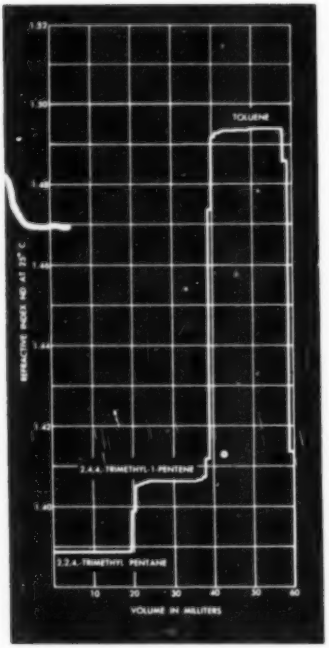

FIG. 1—Sharp separation of a three component solution.

Larger Scale Operations

Assuming the adsorbent accomplishes the desired separation, transposing the laboratory method to larger scale operations has been given added impetus through recent developments in technique. As an illustration, series of five steroid compounds may be very sharply separated on a ¾-in. diameter by 7-ft. height column of silica gel; however, the rate of feed is in terms of several drops per minute over a 24-hr. run. The same separation may be efficiently accomplished on a larger scale without resorting to a slow feed stream of comparable retention time. On the larger column, e.g. 5-in. diameter by 9-ft. height, each adsorbed component may be leached through choice of a desorbing liquid which will displace only one or possibly two of the desired products. In the event more than one is washed from the column by the same liquid, they are usually eluted one following the other due to their solvency differences in the desorbent. It is conceivable that the addition of five distinct solvents one after the other would quickly and effectively yield the five separate compounds.

The traditional methods of regenerating a spent adsorbent involves the application of heat, the economics of such an operation often being a deterrent to commercial practice. Only where the initial cost of the adsorbent is extremely low could disposal after one separation be tolerated.

Sun Oil Co.'s approach to the regeneration problem greatly increases the commercial possibilities for liquid separations by solid adsorbents. Devised is a new continuous process based on the fact that adsorption is an equilibrium phenomenon. The amount of material adsorbed on the silica gel from a mixture is dependent not only on the type of molecule but also its concentration in the original feed-stock. Therefore, desorbing liquid will by a "mass action" substantially desorb the compounds held on the gel. By using a stripping or desorbing agent of lower affinity than the desired mixture on the silica gel, the adsorbent is in effect regenerated and ready to again adsorb from the feed-stock. Obviously, the usual method of regenerating an adsorbent by means of steaming and/or hot gases need not be employed. Heat of wetting effects need not be considered since the regenerated gel is in a wetted condition.

The pharmaceutical and medical advances in several fields have relied to a large degree on selective adsorption processes. Receiving greatest publicity has been the production and use of antibiotics, e.g. streptomycin and penicillin. The culture growth of these antibiotics in large volume liquid media made necessary a method of concentration and separation without destruction of the desirable end product. Selective adsorption was found to be the answer to several of these problems. The concentration and purification of several vitamins in commercial quantities utilize selective adsorption as a highly important processing phase. One company, rather than using columns of silica gel, uses a finely divided high purity gel in slurry form with the feed stock. After agitation, the gel together with the adsorbed liquid is removed from the bulk of the original charge on a vacuum filter.

Steroid hormones and their chemistry have become increasingly important fields of study and application since 1940. The steroids function not only in sex physiology but also significantly affect metabolism regulation. Of recent publicity has been the curing effect of cortisone, an adrenal cortical hormone or steroid, on rheumatic arthritis. These compounds, as are all steroids, are based on a cyclopentanoperhenanthrene nucleus and structurally differ only as to the position, character, and number of substituents. Excellent separa-

tions of a number of steroids have been made using silica gel and other adsorbents. Kendall E and Kendall F, very closely related adrenal corticoids, can be separated on silica gel using a suitable carrying liquid.

A comprehensive study of the steroids excreted in the urine of human beings in health and in sickness has been made at Memorial Hospital, Sloan Kettering Institute for Cancer Research, during the past 11 years. Selective separation of ketosteroids has been an important part of this study. One procedure used short tubes in which the height of the column was generally one to three times the diameter, although column height to diameter ratio of 20 to 30 to 1 was required for some adsorbents. The amount of adsorbent used was 60 to 200 times the ketosteroid content present in the fraction to be chromatographed. The ketosteroid content of 2 to 5% was used in the feed stock using an appropriate solvent. Nitrogen pressure was used to force the solution through the column, and the "cuts" made in 50 to 75 ml. portions. A typical chromatogram resulted in 100 to 260 elutes by using a series of developing solutions. The choice of developer depended upon increasing polarity and followed a sequence, e.g. lignoin, carbon tetrachloride, benzene, ether, acetone, methanol, ethanol, and acetic acid.

The Worchester Foundation For Experimental Biology pioneered in the use of silica gel for steroid separations. As a result of this early work, the silica gels have been widely applied in this medical-pharmaceutical field. Following is an account of a typical steroid separation as made at the Worchester Foundation using a 100-200 mesh silica gel:

Blood containing desoxycorticosterone and corticosterone was extracted to obtain 83 mg. of a syrup. This was dissolved in 25 ml. of benzene and the solution chromatographed on a column 8 mm. I.D. by 18.5 cm. length containing 5 gr. of silica gel. Development and elution of the fractions were made using mixtures of benzene and ethyl acetate, the beginning ratio of benzene to ethyl acetate being 50:1 and portions of 15 ml. were used. Changes to the more polar eluent concentrations were based on the quantity of the two steroids being stripped. In this instance, the desoxycorticosterone was eluted when the ratio of benzene to ethyl acetate was 2:1 and the corticosterone when the same ratio became 1:2.

Pilot plant production of related steroid material is already an accomplishment, however, details on the process have yet to be released. Commercial adoption of liquid selective adsorption for the separation and concentration of aromatics was recently announced by the Sun Oil Co. See "Aromatics for Adsorption", by V. H. Guthrie, Editor, PETROLEUM PROCESSING, August, 1951. The process, designed to alleviate supply limitations of benzene, xylene, toluene, and other aromatics, is flexible and applicable to the recovery and concentration of other hydrocarbons, such as solvents, fuels, and oils.

Two-Phase Continuous Process

Briefly, the continuous process consists of two phases—adsorption and desorption—followed by any refining steps deemed necessary. Feed stock consisting of desired aromatics and also saturates passes through a tower of special silica gel where the aromatics are adsorbed, and the unadsorbed fractions issue from the bottom. When the gel has adsorbed aromatics to a maximum equilibrium, the feed is stopped and desorption is begun. The first of two desorbing solutions removes from the gel any residual saturated material. Following, a second desorbent which by removing or displacing the aromatics is enriched by these aromatics. When desorption is economically complete, the gel bed is ready for fresh feed stock to begin a new cycle.

A typical contemplated charge stock will contain about 35% aromatics, e.g. benzene, toluene. The first desorbent, e.g. butane, will be used to displace the saturated material following which an aromatic desorbent will be used to remove aromatics, the desorbent at the same time being enriched by these aromatics.

Of particular significance is the method of controlling the process cycle. The refractive index of the effluent solutions will be continually observed to assist in switching from one phase to another. In this regard, great strides in the development of measuring devices and methods in recent years offers many suitable methods for controlling an adsorption cycle. Although continuous refractive index checking is often used, visual measurements of turbidity, fluorescence, infrared reflection, ultraviolet and visible color, are sometimes advantageous. Various colorimetric and electrometric titrations are frequently sound approaches to continuous control, and not to be discarded as being too simple are sensory tests, particularly color and odor.

A potential process for obtaining aromatics and olefins of high purity as separated from a variety of petroleum naphtha fractions has been previously reported by California Research Corp. See PETROLEUM PROCESSING, August, 1949, "Refining by Adsorption" by S. Eagle and J. W. Scott. The proposed process, consisting of a series of adsorption towers, would follow a regular cycle consisting of: 1.) raffinate refining; 2.) extract enrichment; 3.) hot stripping; 4.) cooling.

Adsorbent towers would be assigned to each stage depending upon desired purity of raffinate and extract, and retention time required for regeneration and cooling. Here again, the conventional method of regenerating a spent adsorbent with hot gases has been eliminated through use of a hot stripping liquid. The hot stripping not only regenerates the adsorbent but is enriched with aromatics desorbed at the same time. The automatic cyclic operation together with recycling stages is credited with reducing to a minimum the adsorbent, volume of stripping liquid, distillation and heat costs.

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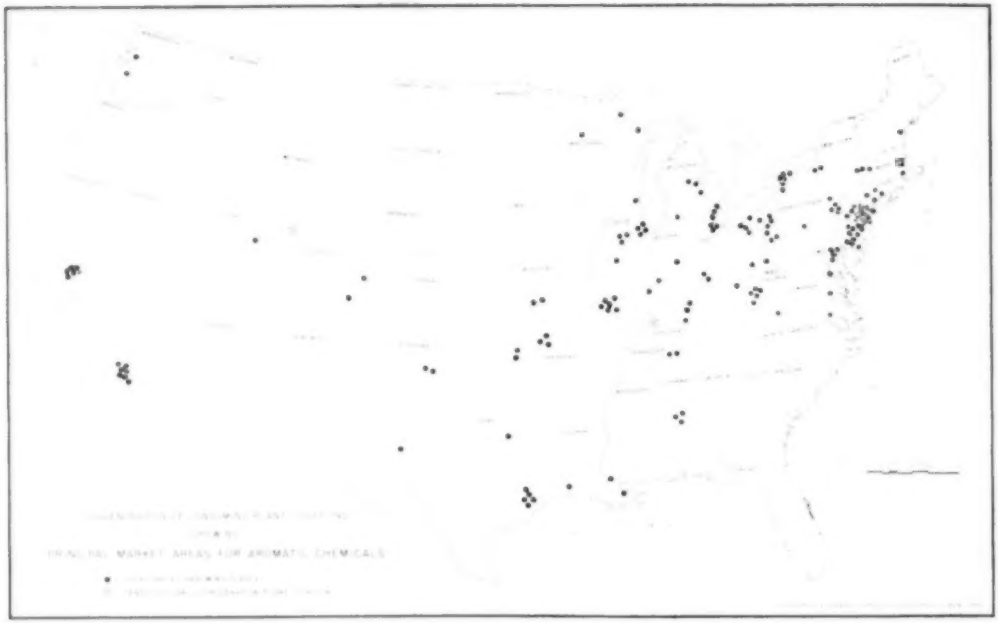

Future Market for Aromatics

Ebasco study of Bureau's synthetic fuel cost estimates forecasts 1955 demand for chemical co-products

AROMATIC chemicals produced in conjunction with a 30,000 b d plant for the hydrogenation of coal to synthetic liquid fuels would probably find a ready market in 1955, according to Ebasco Services, Inc., of New York. These co-product chemicals include benzene, toluene, xylene, phenol, cresol and refined creosylic acid (xylenol)—all chemicals which are now being produced from petroleum and coal tar.

The Ebasco findings were made in connection with its recent review of certain elements of the Bureau of Mines cost estimates for synthetic liquid fuels. The Bureau has proposed that a 30,000 b d synthetic fuel coal hydrogenation plant be built in either Wyoming or West Kentucky. From the operation of such a plant the Bureau contemplates the production of chemicals in the quantities shown in Table 1.

After studying the Bureau's figures and estimates, Ebasco concluded with respect to the chemicals that would be produced that:

"Most of the chemical co-products of a coal hydrogenation plant are vital to many major end-chemical groups and are therefore tied very closely to the rapidly expanding needs of the chemical industry. Demand for these materials rose sharply during World War II and in the postwar period, paralleling the rapid development of plastics, synthetic detergents and other branches of the chemical industry in which the aromatic chemicals are essential. Growth trends and authoritative estimates of future expansion in these industries give every indication that the demand for these chemicals will continue to increase.

"Market analysis indicates that, with the exception of m-p-cresol the amounts of chemical co-product yields from a plant in Wyoming or in West Kentucky, as specified by the Bureau of Mines' estimate dated Oct. 25, 1951 and revised as of Jan. 11, 1952, could be effectively marketed by 1955 at prevailing prices."

On the subject of cresols, Ebasco recommended that annual output from either of the Bureau's proposed plants be set at 50,000,000 lbs., instead of the levels given by the Bureau in Table 1. On all other chemical output figures, Ebasco agreed with those in Table 1.

No attempt was made by either Ebasco or the Bureau to forecast level of prices for these chemicals in 1955, and prices as of Jan. 1, 1951 were assumed in making all estimates, unless otherwise specified. "It should be noted," the Ebasco report states, "that the estimates of

Table 1—Estimated Annual Volume of Co-Product Chemicals from a 30,000 b d Coal Hydrogenation Plant*

	Wyoming	Kentucky
Benzene, gals	11,250,000	12,750,000
Toluene, xylene, gals	39,300,000	42,900,000
Phenol, lbs	45,900,000	77,000,000
m-p-Cresol, lbs	64,800,000	77,000,000
o-Cresol, lbs	6,900,000	6,900,000
Xylenol, lbs	25,000,000	25,000,000
Naphthalene, solidifying, tons	120,000	120,000
Sulfur, tons	17,100	30,000

* These figures are the Bureau of Mines estimates of the volume of products considered marketable by 1955 from either plant, taking into account the type of coal which would be used and the location of the plant with respect to markets.

marketable quantities and resulting revenues in this report have been significantly affected by this assumption. There are indications that the future market for cresols might be substantially increased at a lower price which would provide a margin below the phenol level. At the same time, many informed sources have indicated that more realistic future prices of benzene and phenol will probably be at somewhat higher levels than those of Jan. 1, 1955.[7]

As part of its study of the revenue which the Bureau anticipates from the co-product chemicals produced in a coal hydrogenation operation, Ebasco reviewed the growth trends in the production and consumption of the chemicals themselves, and made an analysis of scheduled plans for their future output from all sources.

Since all of these aromatic chemicals are or can be produced from petroleum on a large scale, PETROLEUM PROCESSING presents below that portion of the Ebasco report which covers the present and future markets for them.

Benzene

Production Trends—The production of benzene since 1939 is shown in Fig. 2. Because of the tremendous demand for this chemical, the 1951 supply was raised to an estimated 280 million gals. by an increase in the output from coke-oven light oil, new capacity for petroleum benzene production and greatly expanded imports. The total current supply amounts to more than six times consumption as a chemical raw material in 1940.

Annual benzene demands to 1955, which were estimated by an industry task group under the sponsorship of the National Production Authority, late in 1950, are shown in Table 2. These amounts were based on estimated requirements for the principal usages for which benzene is required, such as styrene for making rubber and plastics, synthetic phenol, aniline, nylon, detergents, and many other chemical applications. The projected mobilization requirements are for conditions short of full-scale war, in which case other factors would have to be taken into consideration which would probably alter the requirements somewhat.

Use Pattern—Table 3 indicates the annual consumption of benzene by end uses since 1948, as estimated by the American Coke & Coal Chemicals Institute.

Currently about one-third of the present estimated 280 million gals. supply is going into styrene, which is the fastest growing use. Styrene capacity is being increased by about 200 million lbs. a year, and by 1955 almost half of the projected 400 million gals. benzene requirement is expected to go into styrene production. At present more than half of the styrene is used to produce synthetic rubber, the remainder is not sufficient to fill the growing demands for polystyrene for plastics, resins for water purification and softening, styrene-butadiene resins which are used for such products as floor tile and shoe soles, and reinforced lightweight plastics which use a styrene polyester resin reinforced with fiber glass. The latter use is still new and has a vast potential for structural pieces such as paneling and pipe and could become one of the largest volume uses of styrene for military as well as civilian applications.

Synthetic phenol, the second largest consumer of benzene, has a present capacity of 350 million lbs. a year and currently uses about 20% of the supply. The National Production Authority has set a goal for phenol capacity increase by 1955 of about 280 million lbs. over January, 1951 capacity and this production is expected to use about 80 million gals. by 1955.[10]

Aniline, now in short supply because of increased requirements for processing synthetic rubber, used about 18 million gals. of benzene in 1951 and will be increased at least 20% in the immediate future. The rest of the benzene is used for nylon, D.D.T., maleic anhydride, synthetic detergents, insecticides and miscellaneous intermediates. It has been stated that although detergent capacity in 1951 was about 1.2 billion lbs., it would be increased to 2 billion lbs. if sufficient benzene were available.

The sixfold increase in the use of benzene as a chemical raw material since 1940 has brought about an acute shortage. This shortage is becoming more critical with the rapidly increasing demands resulting from the mobilization program, even under normal conditions. The growing consumption of benzene-derived civilian products would present a real supply problem. The estimates which have been made for demand growth are based on the consumption of known products, many of which were not on the market ten years ago. It is safe to assume that many new prod-

Table 2—Estimated Benzene Requirements by Product, 1951 to 1955[10] (figures in millions of gallons)

	1951		1952		1953		1954		1955	
	N	M	N	M	N	M	N	M	N	M
Phenol	50	58	61	75	84	86	47	85	50	70
Styrene	80	86	95	130	105	130	115	170	130	190
Aniline	14	18	14	19	14	20	14	21	15	22
Nylon	20	25	20	25	20	25	20	25	20	25
D. D. T.	5	5	5	5	5	5	5	5	10	10
Explosives	3	3	3	4	3	4	3	4	3	4
Maleic Anhydride	9	9	12	12	15	15	15	15	15	15
Sulfonic Detergents	12	13	14	16	15	17	16	19	18	20
Dichlorobenzene	5	6	5	6	5	6	5	6	6	7
Methylstyrene*	4	5	4	5	4	5	4	5	5	6
Nitrobenzene**	4	4	4	4	4	4	4	4	5	5
Benzene Hexachloride	4	4	4	4	5	5	6	6	7	7
Miscellaneous	13	13	13	13	13	13	25	27	25	27
Added Insecticides for Military		2		3		5		8		9
TOTALS	222	252	243	305	282	338	289	329	315	431

* Other than for intermediate phenol, aniline and D. D. T.
** Other than intermediate for aniline and D. D. T.
N—Demands under normal economy.
M—Demands under all out mobilization.

Table 3—Estimated Benzene Consumption by End Use, 1948-1952 (figures in millions of gallons)

End Use	1948	1949	1950	1951	1952
Phenol (synthetic)	35	30	41	47	58
Styrene	47	48	63	82	107
Aniline	13	10	14	16	17
Nylon	18	18	20	20	20
D. D. T.	1.5	3	5	12	14
Explosives	3	3	3	4	4
Maleic Anhydride	2	1	3	5	5
Synthetic Detergents	7	10	10	17	18
Diethyl-Benzene	5.5	4.5	5	6	6
Methylstyrene*	5	3	3	5	5
Nitrobenzene**	4	3	4	4	4
Benzene Hexachloride	1	1.5	2	4	4
Miscellaneous	14	9	10	20	20
Export	5	1	1	4	4
TOTALS	162	145	189	256	295

* Other than for phenol, aniline and D. D. T.
** Other than for aniline and D. D. T.

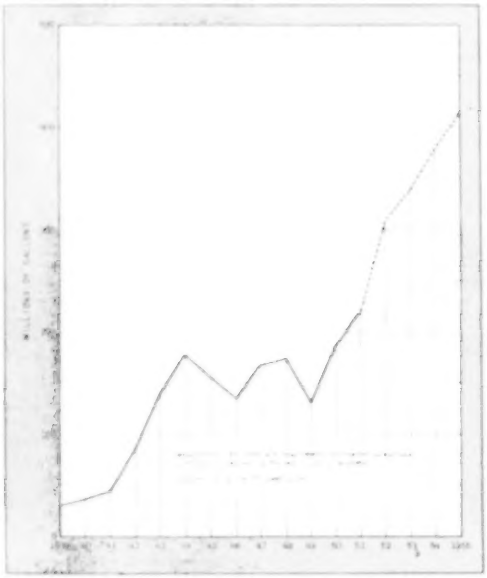

FIG. 1—BENZENE production in the U. S. (chemical grade).

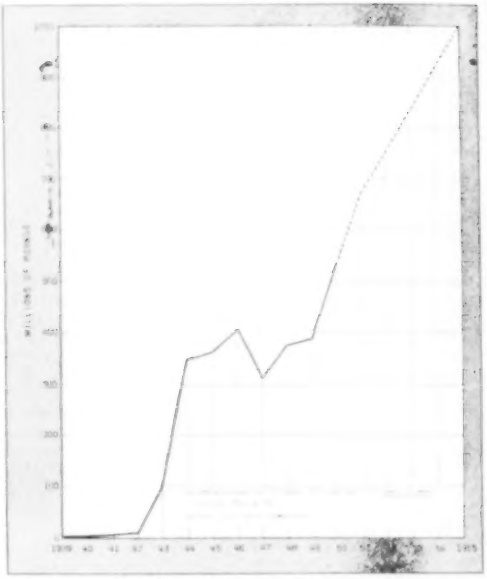

FIG. 2—STYRENE production in the U. S.

acts will probably be developed through research. It has been stated that "... every effort should be made to reach a production of over 100 million gals. of benzene annually by 1955."[7]

Outlook for Additional Supplies—In view of the growing demands and the estimates of increased future requirements for benzene, efforts have been made to increase coke-oven benzene production, but 190 million gals. annually is expected to be the maximum to be obtained from this source. Although increased imports which amounted to about 60 million gals. helped to ease the shortage in 1951, it must be remembered that the tight supply situation is world-wide. It is doubtful if imports can be maintained at that level, and there is always the chance that they might be cut off entirely. Therefore, it is apparent that even if the goal is met for greatly increased production from petroleum which is scheduled to expand to 147 million gals. in the next two years,[7] the total supply will still be insufficient to meet the estimated requirements of over 400 million gals. in 1955 unless additional capacity is provided for.

Styrene—The trend of production of styrene, which uses about one-third of the benzene supply, is shown in Fig. 2. During World War II, styrene production moved mainly because of the requirements of the synthetic rubber program, which took about two-thirds of the supply, the balance going into resins for plastics.

Since 1939, styrene production has climbed from less than a million lbs. a year to 539 million in 1950, and an estimated 670 million lbs. in 1951. Estimated production in 1952 is expected to be over 750 million lbs. and about a billion lbs. in 1955.[10]

In addition to being one of the major components of GR-S (Buna S) rubber, each ton of which requires about 500 lbs., styrene is also the principal component of polystyrene, one of the most popular and widely used plastics. It is the cheapest of all rigid thermoplastic materials, and has excellent electrical properties, high clarity, and high water and chemical resistance. Materials similar to the plastic armor, Doron, a polyester styrene resin will probably see expanded use. The use of polystyrene plastics has grown very sharply since the last war and in 1949 plastics usage of styrene exceeded synthetic rubber requirements.

It has been estimated that by 1962, GR-S rubber requirements will be 600,000 long tons, requiring about 335 million lbs. of styrene yearly. Requirements for plastics by 1962 have been estimated at 900 million lbs. for a total demand for styrene of 1,235 million lbs. from these two uses alone, which in turn would require about 150 million gals. of benzene.[10]

There are also indications that styrene may find a considerable market in the nonplastic field. Among these nonplastic uses are the impregnation of magnesium castings and the replacement of drying oils in paints.

The following tabulation shows the future demand for styrene for use in synthetic rubber and plastics, as estimated by the Chemical Division of the National Production Authority.

Data are in thousands of pounds:

Year	Syn. Rub.	Plastics	Total
1950	300,000	340,000	640,000
1951	500,000	725,000	1,225,000
1952	600,000	775,000	1,375,000
1953	750,000	950,000	1,700,000
1954	850,000	1,100,000	1,950,000
1955	850,000	1,250,000	2,100,000

Toluene

During World War II, toluene usage was almost entirely for explosives and for aviation gasoline. However there is a mounting demand for toluene as a chemical building block which should provide a more solid footing for peacetime production. It is required for cresols and is the forerunner of many derivatives for fine chemicals, drugs, and dyes. It is now seen as a raw material for chemicals made in large volume and as a potential challenge to benzene. Two examples are alkyl toluene sulfonate for detergents, and vinyl toluene, the latter being a product with properties like styrene.

Toluene, as a basic material for T.N.T. and as an aviation gasoline component, is of particular significance in the mobilization program. During World War II an estimated 77% of the toluene production was

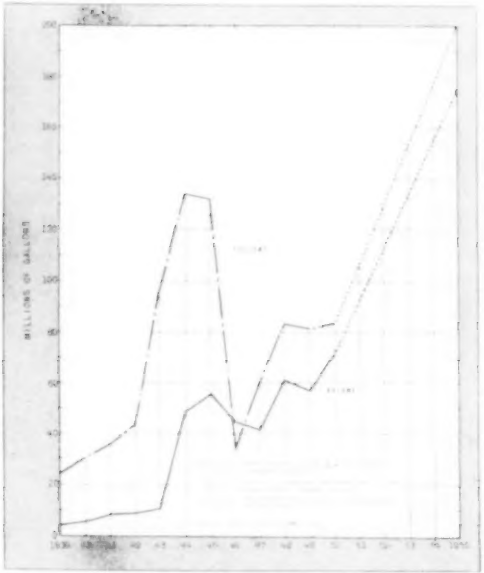

FIG. 3—**TOLUENE** and **XYLENE** production in the U. S.

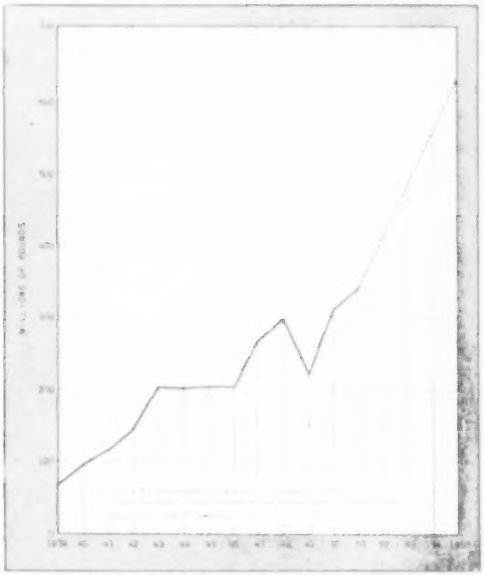

FIG. 4—**PHENOL** production in the U. S.

used for explosives and direct military use, and about 17% was used for aviation gasoline. Even though toluene production mainly for these purposes reached an all-time high in 1944 of 134 million gals., exclusive of what was produced at petroleum plants under Ordnance control, the post-war production of 83.8 million gals. in 1950 was more than three times the 1939 production of 24.3 million gals. (See Fig. 3.) The exact amount of toluene consumption during Word War II is restricted information but in a war economy demands for this chemical probably would rise sharply, although atomic weapons might replace a significant amount of T.N.T. for military usage.

Toluene is also used for solvents and saturants, dyes, protective coatings, detergents, and miscellaneous chemical manufacture. Toluene may supplement and replace benzene for many uses. For example, it is understood that one chemical company is instituting a method of using vinyl toluene instead of vinyl benzene for synthetic rubber. It is understood that the toluene requirement for two plants using this process would be 1½ million gals. of toluene per month. Methyl styrene derived from toluene could find extensive usage as a replacement and supplement for styrene made from benzene.

The present production planning of the petroleum industry to meet the urgent needs for benzene will also make additional toluene available, so that annual capacity will soon be about 200 million gals. a year compared to the 85 million gals. in 1950. In case of war, probably more toluene and xylene will be used for aviation gasoline, replacing that which came from benzene-based cumene in World War II, because of the current critical benzene situation. Aviation gasoline and explosives would take most of the toluene in wartime. The biggest present peacetime use is for solvents and thinners in the paint industry, which uses about half the civilian supply. But this share is due to decrease, because either in war or peace, toluene is slated for a bigger and more important part in the chemical field.[5]

Xylene

The production of xylene has risen even more sharply than toluene. It hit a wartime peak in 1945 of 55.8 million gals., and its all-time high of 71.8 million gals. in 1950 compares with a production figure of only 4 million gals. in 1939, as shown in Fig. 3.

The use pattern of xylene includes protective coatings, gasoline blends, phthalic anhydride, xylidines and other chemical uses. It is used in the manufacture of dyestuffs, artificial musk, trinitroxylene, as a solvent in making rubber cements, lacquers and varnishes. Continuing shortages of naphthalene for phthalic anhydride which is in great demand for plastic resins and plasticizers, have resulted in making ortho-xylene increasingly important for this use. The new synthetic fiber, Dacron, is derived from terephthalic acid from para-xylene, and projected facilities for the manufacture of the new fiber necessitate a great increase in production of para-xylene.[5] It seems logical to expect Dacron and other synthetic fibers to follow a growth curve such as was experienced after the introduction of rayon. On this basis, future Dacron capacity has been estimated at 35 million lbs. in 1953 and 123 million lbs. in 1962.[5] It is believed that production of this fiber may eventually approach the 200 million lb. nylon output. Meta-xylene is used for isophthalic acid for plasticizers and increased volume is also seen for this use.

With increased benzene-from-petroleum production facilities, will come more xylene, and under current plans this gives a xylene output of about 175 million gals. compared to about 71 million gals. in 1950. Under present mobilization conditions, the demand for aviation gasoline and shortages of other materials will tend to retard the chemical development of xylene and its new derivatives, such as the isophthalic plasticizers for which industry reports predict large scale utilization of meta-xylene.[5]

The most characteristic feature of xylene for industrial application seems to be its great potentiality for future growth. Availability and prod-

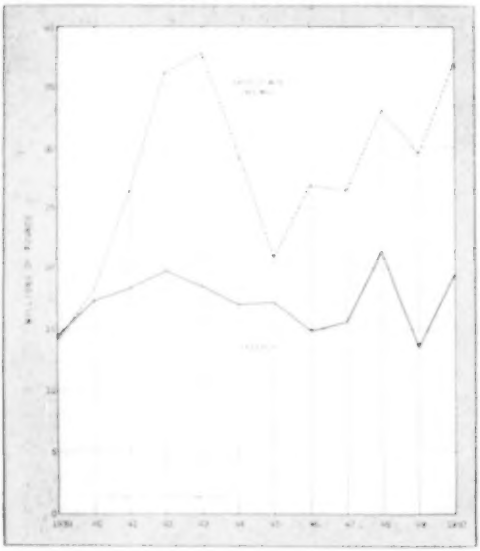

FIG. 5—CRESOLS and CRESYLIC ACID (refined) production in the United States

of diversification seem to indicate a big future for xylene and its derivatives.

Phenol

Production Trends The production of phenol has increased nearly five times from 68.5 million lbs. in 1939 to about 312 million lbs in 1950, as shown in Fig. 4. This growth is due largely to the greatly increased demands brought about by the tremendous expansion during the past decade of the plastics industry, the largest user of phenol.

Most of the growth in phenol output has been due to increased production of the synthetic product, which is dependent upon the benzene supply. Over 90% of the total phenol output is produced from benzene. Synthetic phenol is expected to use about 80 million gals. of benzene by 1951 when presently planned capacity comes into production. The amount of natural phenol available is limited to the amount of coal tar distilled and production is not expected to go much above 25 million lbs annually from this source.

Phenol is so vital to our present economy that it ranks near the top in the National Production Authority's essential list. Because of continually expanding demands for phenol and since capacity has been insufficient to meet demand, the Defense Production Administration has announced a new expansion goal to boost annual production to 623 million pounds by early 1955. This goal was determined in order to meet the estimated requirements of defense and essential civilian production at that time.

Use Pattern Between 65% and 70% of phenol production goes into the manufacture of phenol-formaldehyde plastics for molding powder, laminating resins, protective coatings, plywood adhesives, molding resins, waste wood recovery resins, and other uses, all of which are important in civilian production, as well as for parts for planes, tanks, ships and other military equipment.

Phenol is used extensively by the petroleum industry as a solvent for refining lubricating oils and for oil additives and emulsion breaker chemicals. It is also used extensively in the agricultural chemical field for selective weed killers and herbicides such as 2,4-dichlorophenoxyacetic acid (2,4-D) and its derivatives. Phenol requirements for these materials in 1948 were 8 million lbs. It has been estimated that the phenol requirement for herbicides of this type would soon reach 45 million lbs. a year or more.[5] Other phenol derivatives such as dinitrophenol serve as weed killers as well as insecticides.

Still other phenol derivatives are used in the manufacture of insecticides, disinfectants, fungicides and germicides. Pentachlorophenol has shown especially rapid growth in recent years. Its principal use has been as a wood preservative to minimize damage from rot and termite attack. Phenol is also a base raw material for drugs, pharmaceuticals and dyestuffs.

Though large amounts of phenolics go for defense purposes, civilian consumption is considerably greater and destined for a new upsurge. Huge tonnages will be needed in making foundry molds and for bonding wood wastes. Many observers believe these markets will develop quickly and reach considerable proportions.[5]

Supply Outlook The production goal set by the Defense Production Administration for 623 million lbs. of phenol by 1955 has been mentioned. This will be 280 million lbs. above productive capacity as of January 1, 1951. One new installation began operation in 1951 and another 60 to 80 million lbs. of new capacity is scheduled to begin production in 1952. Applications for rapid tax amortization for increased capacity of 277 million lbs. a year have been filed, and capacity for 162 million lbs. have been approved. It is believed that DPA's recently announced goal will expedite the approval of the balance so that the goal may be reached.[5]

Present plans for additional production, however, are being hampered by steel and equipment shortages. The higher cost of petroleum benzene, which is currently about 55c a gal., has tended to raise the price of phenol about 1c to 2c a lb. and it is now quoted at about 19½c a lb. This has caused a price squeeze on phenol buyers who purchase about half the production, the other half being captive.[5]

Cresol and Cresylic Acid (Xylenol)

The supply of cresol, being almost entirely dependent upon the output of coke-oven plants, has been relatively stable over the past decade as Fig. 5 indicates. These tar acids are at present in the least short supply of all the aromatic chemicals, but since about 60% of cresol is used for plastics and plasticizers, the supply situation could become tight as the defense program is accelerated. Para-cresol is vital for use in making insulating compounds, electric panel boards and dyes.

Tricresyl phosphate, which is used as a plasticizer for vinyl resins and in phenolic resins, is a significant user of cresylic acid at present. It is understood that a new use for tricresyl phosphate which is being explored may result in an important additional demand for cresylic acid. Tricresyl phosphate used considerable amounts of cresylic acid during World War II in connection with degaussing ships.

Cresol is also used for cleaning

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Here's An Effective Way To Keep Oil Free-Flowing

The problem of keeping oil in storage tanks free-flowing under adverse weather conditions is easily solved with use of an SK Fig. 1043 Oil Heater.

Construction of this versatile heater assures uniform heating and, because of minimum resistance to oil flow, entails very low over-all pressure loss.

In this heater, the steam is admitted through tubes and the oil flows around the tubes. The tube bundle consists of a tube sheet and "U" tubes —the ends of which are polished and rolled into the tube sheet. The main header can be removed without disturbing the joint between the tube sheet and the shell. All heaters of this type are hydrostatically tested to 250 psi on the tube side.

As shown in Fig. 1043-A, the heater is furnished with a flange for bolting or welding to the storage tank manhole. Steam is admitted through the steam inlet and into the tubes. Oil, from the storage tank, flows into the shell from the open end, flows around the tubes, between the baffles, and discharges through the oil outlet. Because the shell opening is beveled, the oil flows with minimum resistance, which helps keep the over-all pressure loss low.

As shown in Fig. 1043-AA, exhaust steam is eliminated through the drain in the under side of the header.

For complete details on SK Fig. 1043 Oil Heaters, request Bulletin 10-F.

FIG. 1043-A. THE SK TANK TYPE OIL HEATER FOR OIL STORAGE TANKS

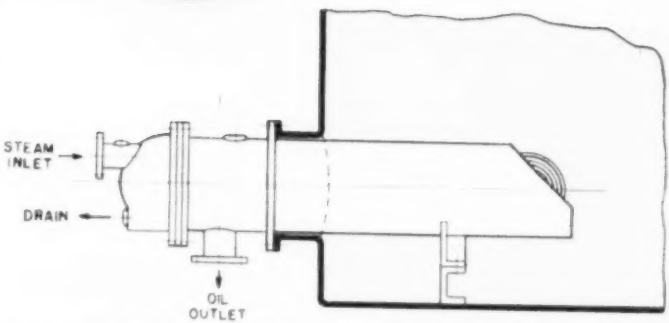
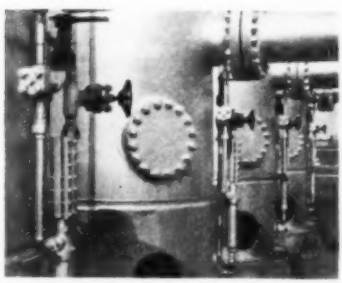


FIG. 1043-AA. SIMPLIFIED DRAWING SHOWS HOW TANK TYPE HEATER IS USED ON OIL STORAGE TANK

FOR MEASURING FLOW IN OIL SCRUBBERS

At a large southwestern gas pipeline plant, SK Armored Rotameters, with bolted cast steel gage glass indicator as shown in photograph, are used to indicate flow of scrubber oil circulated in oil scrubbers for hydrocarbons at 1,000 psi working pressure.



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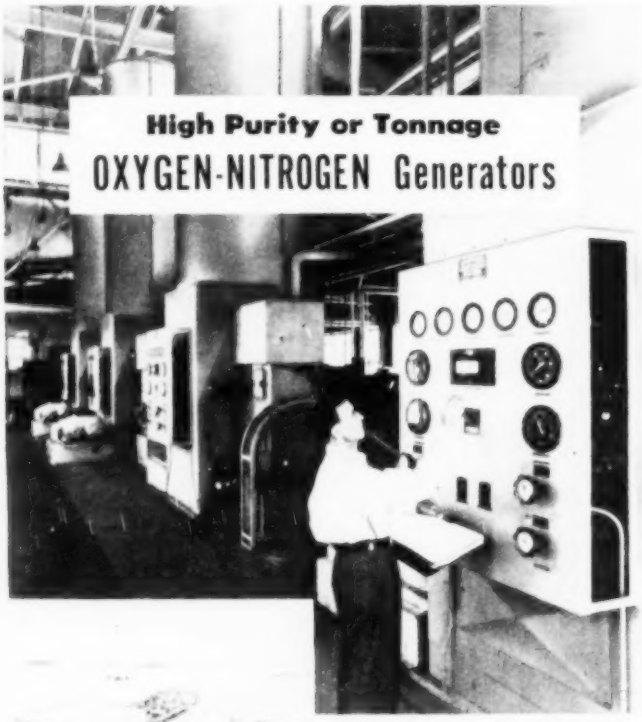

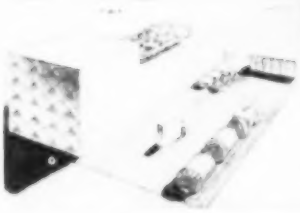

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engine parts, as an additive for lubricants and for ore flotation. The use pattern,[18] percentagewise, for cresol and cresylic acid is as follows:

Plastics and plasticizers	40%
Ore flotation chemicals	15
Disinfectants and insecticides	10
Textiles, medicines, dyes and inks	10
Other, including petroleum refining	25
Total	100%

There has been no chronic shortage of cresol and cresylic acid, but some authorities believe that research to develop new usages has been restricted because of the necessarily limited supplies. It has been stated that the market for these chemicals could be appreciably increased at approximately 75% of the price of phenol.

Major Market Areas

The accompanying map, p. 1154 shows the major market areas for aromatic chemicals as indicated by the concentration of consumers. On it have been located many of the plants of the major consuming industries.

By and large the market areas conform very closely to the areas of concentration of the chemical industry as a whole and particularly such allied industries as plastics, synthetic rubber, detergents, insecticides, and miscellaneous related industries. Many of these consuming companies are also producers of aromatic chemicals, but those organizations who are primarily producers have usually not been included. Many of the plants of most of the companies who are present or potential users have been spotted on the map in order to show a general pattern of consumption by geographic areas.

As is indicated on the map, the major markets for aromatic chemicals are concentrated principally in the Middle Atlantic states and the Middle West.

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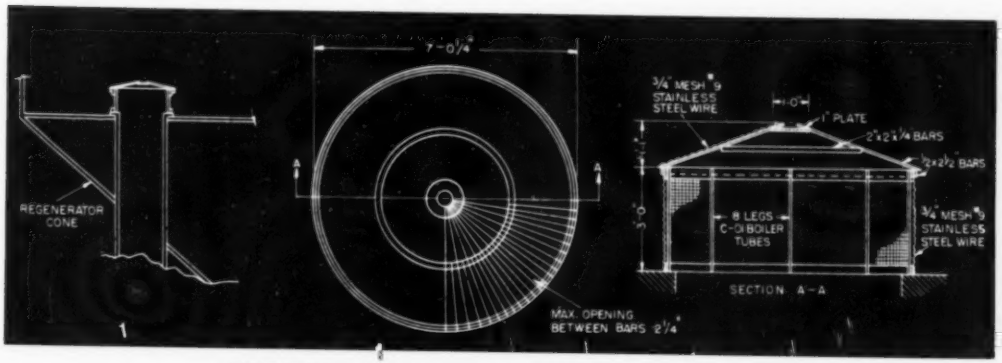
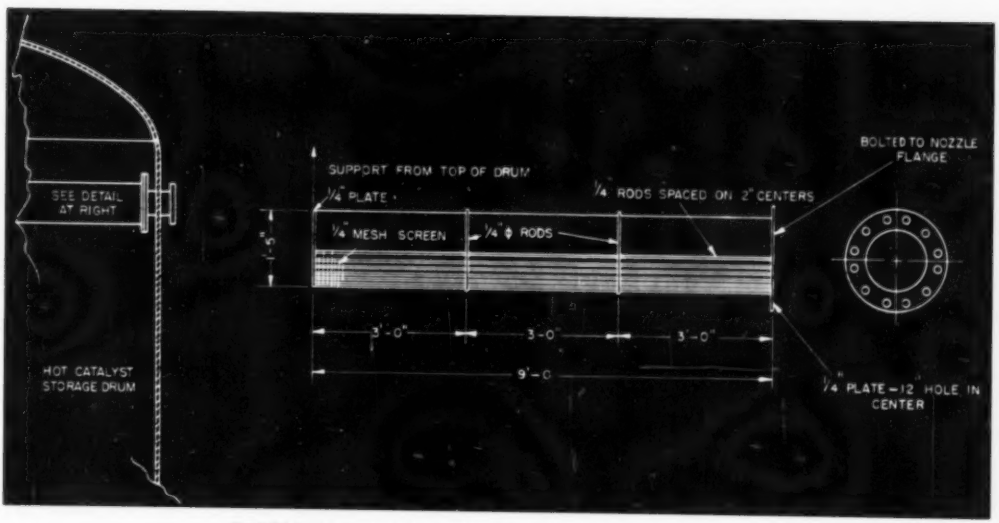


PROBLEM 1—solved by a "birdcage" at the regenerator bottom



PROBLEM 2—solved by a "basket" in the catalyst storage drum

"Baskets" Stop Fluid Unit Damage

BASKETS," or "birdcages," installed at various points in the Fluid catalytic cracking unit have neatly solved a problem for Utah Oil Refining Co. at their Salt Lake City refinery.

The problem was two-fold: 1) refractory had been spalling off the side walls of the regenerator and passed down through the line to the recycle catalyst cooler where it had been damaging the boiler tubes; and 2) spalled refractory and miscellaneous small metal parts had been getting into the hot catalyst storage drum and jamming the 2-in. slide valve at the bottom, on the catalyst return line to the unit.

Problem No. 1 was whipped by installing a large and ruggedly built strainer over the entrance to the line from the regenerator to the recycle catalyst cooler, welded securely to the distribution grid. This strainer, built like a big round bird cage or inverted basket, comprised a framework using the damaged boiler tubes as vertical upright members, and a cone roof arrangement made of ⅝ x 2½" flat iron. The frame was then covered with a stainless steel screen of ¾" mesh, #9 wire, to keep everything except catalyst from passing through.

Problem No. 2 was licked by approximately the same technique. A "basket" of somewhat similar construction was built and installed in a sideways position inside the hot catalyst storage drum at the inlet of the hot catalyst return line. In this case, the basket catches the unwanted debris inside it and therefore must be cleaned out occasionally.

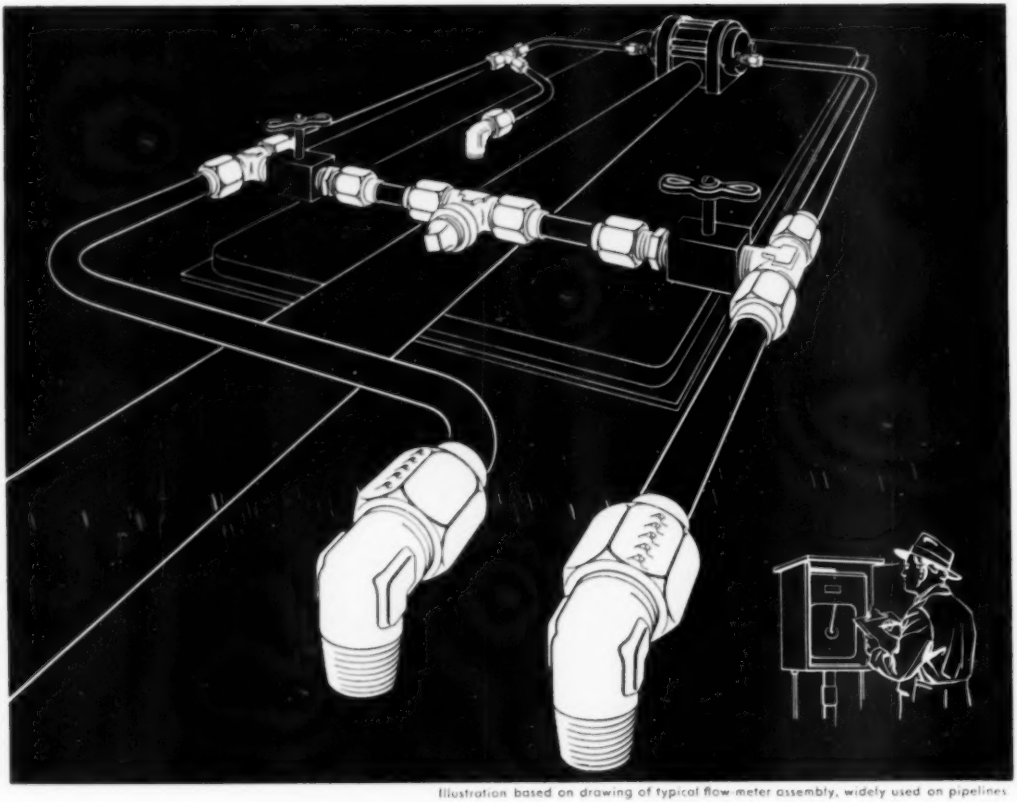


Illustration based on drawing of typical flow meter assembly, widely used on pipelines

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EXPORT	Mercator Corp. 438 Walnut St. Reading, Pa.
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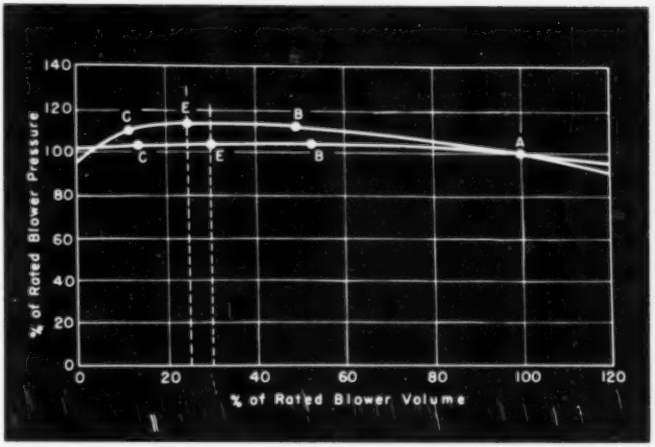

TYPICAL PRESSURE-DELIVERY curves for centrifugal blowers

Blower Surging—Cause and Cure

WHEN a centrifugal blower is used in the capacity range for which it was designed, pulsation is seldom a problem. However, there are certain applications where it is necessary to keep the blower running during periods of very small demand. These "turn-down" or "week-end holding" periods may call for as little as 10 or 20% of rated volume output of the blower. In such cases, surging can set up a pulsation which may disturb the process and cause overheating with consequent damage.

Such pulsations can be prevented and corrected—with a knowledge of the mechanics of pulsation and the characteristics of a centrifugal blower.

The pressure-vs-delivery curves shown in the chart are typical of all centrifugal blowers, the upper curve being of a well-designed blower, and the lower curve of a "not-so-well" designed blower. In both cases, the pressure attains a maximum high point at some relatively low rate of air output, the curve rising at air delivery rates below this critical value and descending at rates above this critical value.

If the demand on a blower is decreased in volume from a normal operating point, **A**, to another normal operating point, **B**, above the maximum-pressure point, the pressure at the blower merely rises correspondingly, and pulsation does not occur. If, however, the load or volume requirement is decreased beyond the maximum-pressure point, **E**, to a very low point, such as **C**; the following sequence of circumstances may set up surging.

The blower delivery pressure first decreases from **E** to **C** *at the blower itself*. Thus for a moment, the pressure in the piping system connected to the blower is greater than the pressure at the blower itself. Thus the air in the line tends to reverse its direction and flow back into the blower until both pressures become equalized. This can be extremely dangerous in handling gas to a burner or combustion chamber. When the pressures become equalized, the blower again resumes its normal function of pumping air into the system—until the restriction at the line outlet again reduces throughput and causes the sequence to repeat.

This repetition is what constitutes surging.

Its frequency and intensity depends upon: 1) the slope of the pressure-vs-volume curve, 2) the rate at which air is being removed from the system, and 3) the volume of the pipe system to which the blower is delivering. The same principles apply whether the centrifugal unit is operating as a blower or an exhauster.

The wisest action to take in the prevention of pulsation is to anticipate the circumstances which might cause it. The phenomenon will not occur in volumes above the point **E**. If the application is such that low turn-downs are expected, it is prudent to so indicate when the blower is being ordered. A blower manufacturer can, in most cases, select and specify to prevent pulsation.

If, however, pulsation or surging is noticed in a finished installation, any of the following five steps can be taken.

1. Consider the economics of replacing the blower with a smaller

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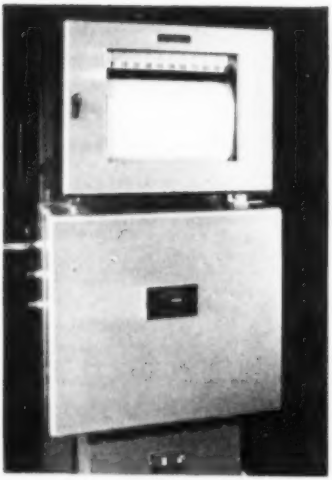

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capacity unit having, consequently, a lower surge point.

2. Consider purchasing a small capacity unit for turn-down periods.

3. Make sure that the amount of air delivered by the blower is always above the surge point by bleeding enough air out of the system beyond the blower. If gas is being handled rather than air, it will be necessary to recirculate this bleed flow back into the blower inlet. If the bleed is recirculated, however, remember that you are compressing and re-compressing that portion of the gas, and building up the blower temperature to a point which may be detrimental.

4. If the surging is infrequent and of short duration, it may not be harmful to the blower at all. Surging at the point of air or gas use may be eliminated by adding a surge tank or by increasing the cubical content of the piping in front of the nozzle.

5. Ask the manufacturer to make minor changes in the blower design to permit by-passing of the air, or take other steps which will eliminate the troublesome pulsation at the sacrifice of a little blower efficiency or tightness of the installation.

Actually, the more efficient a blower operates and the tighter the air system is beyond the blower, the more likely it is to surge at very low operating points. Fortunately, the uses for compressed air or gas which demand blower operation at critically low output are infrequent so that the use of high-efficiency equipment is satisfactory in all but the rarest of cases.

Based on information supplied by O. Q. Acheson, Billmyre Blower Div. Lamson Corp.

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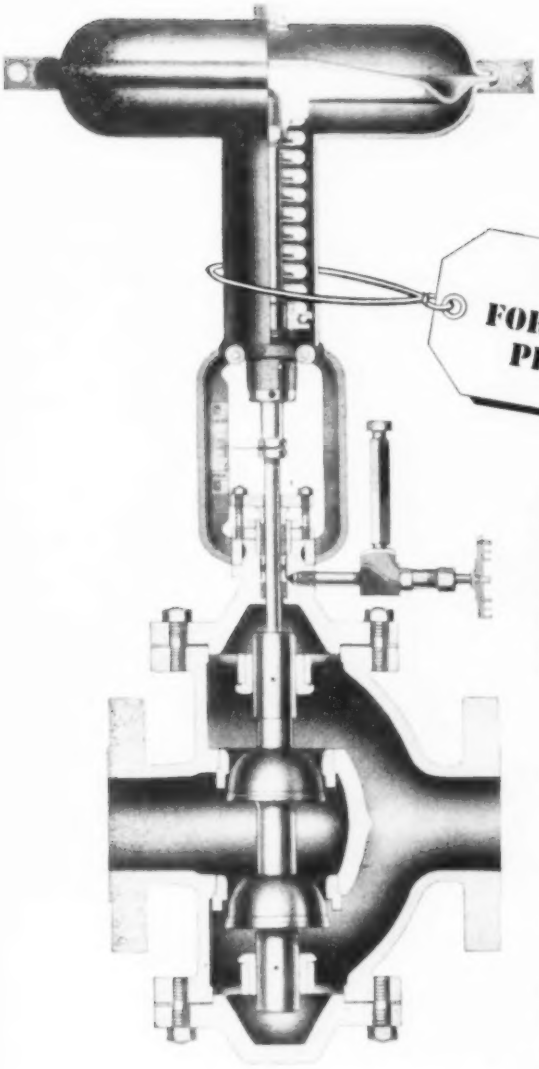

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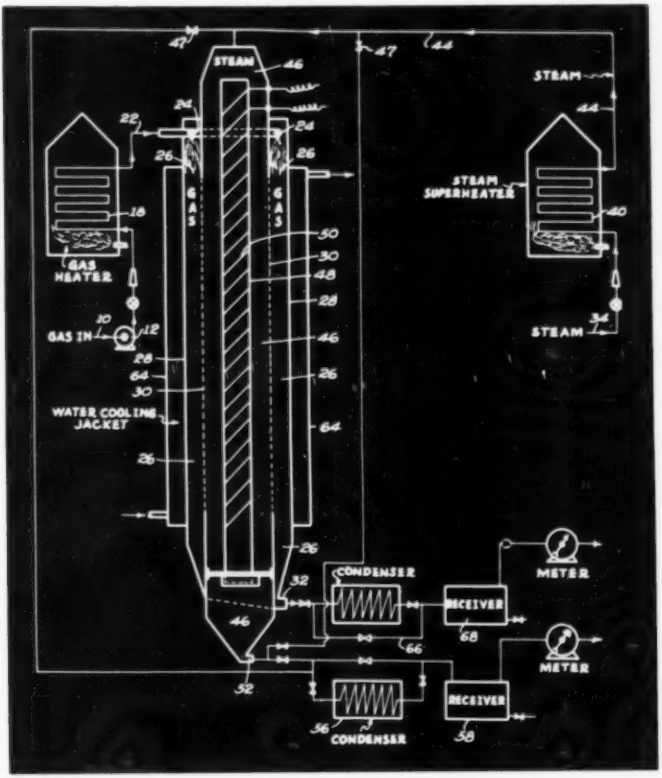
By Peter J. Gaylor, Patent Attorney, Gaylor, Cifelli & Jurick, Newark, N. J.



GASEOUS DIFFUSION apparatus developed by Koppers Co. and using steam as sweep medium (U. S. 2,589,297)

Koppers' New Gas Diffusion Process Uses Steam as Sweep Medium

ALTHOUGH commercial separation of gases by diffusion is done on a large scale in the production of uranium 235, this fact, by itself, is not conclusive that the process is commercially more attractive for the petroleum industry than other conventional gas separation processes. However, sometime ago, some publicity was aroused in the petroleum industry by the possible commercial prospects of diffusion processes, so that it might be appropriate here to outline one method described in a recent patent (2,589,297) issued to the Koppers Co.

In separating a constituent of a gas by diffusion, it is customary to pass the gas along one side of a porous boundary or diaphragm, and a sweep medium along the opposite side of the boundary. The constituent being separated from the gas, passes through the boundary, and the sweep medium acts to sweep the constituent away from the boundary. The rate of diffusion of the gas constituent in one direction and of the sweeping medium in the other is inversely proportional to the square of the sum of the molecular diameter of the constituent and of the molecular diameter of the molecules composing the sweep medium. The rate of diffusion also is proportional to the square root of the sum of the reciprocal mass of the constituent and of the reciprocal mass of the molecules composing the sweeping medium. The total amount of gas transferred through the porous boundary depends, in addition on the controllable pressure difference across the boundary. In other words, superimposed on the diffusive transfer of gas there is a transfer of gas across the boundary because of pressure differences on opposite sides of the boundary.

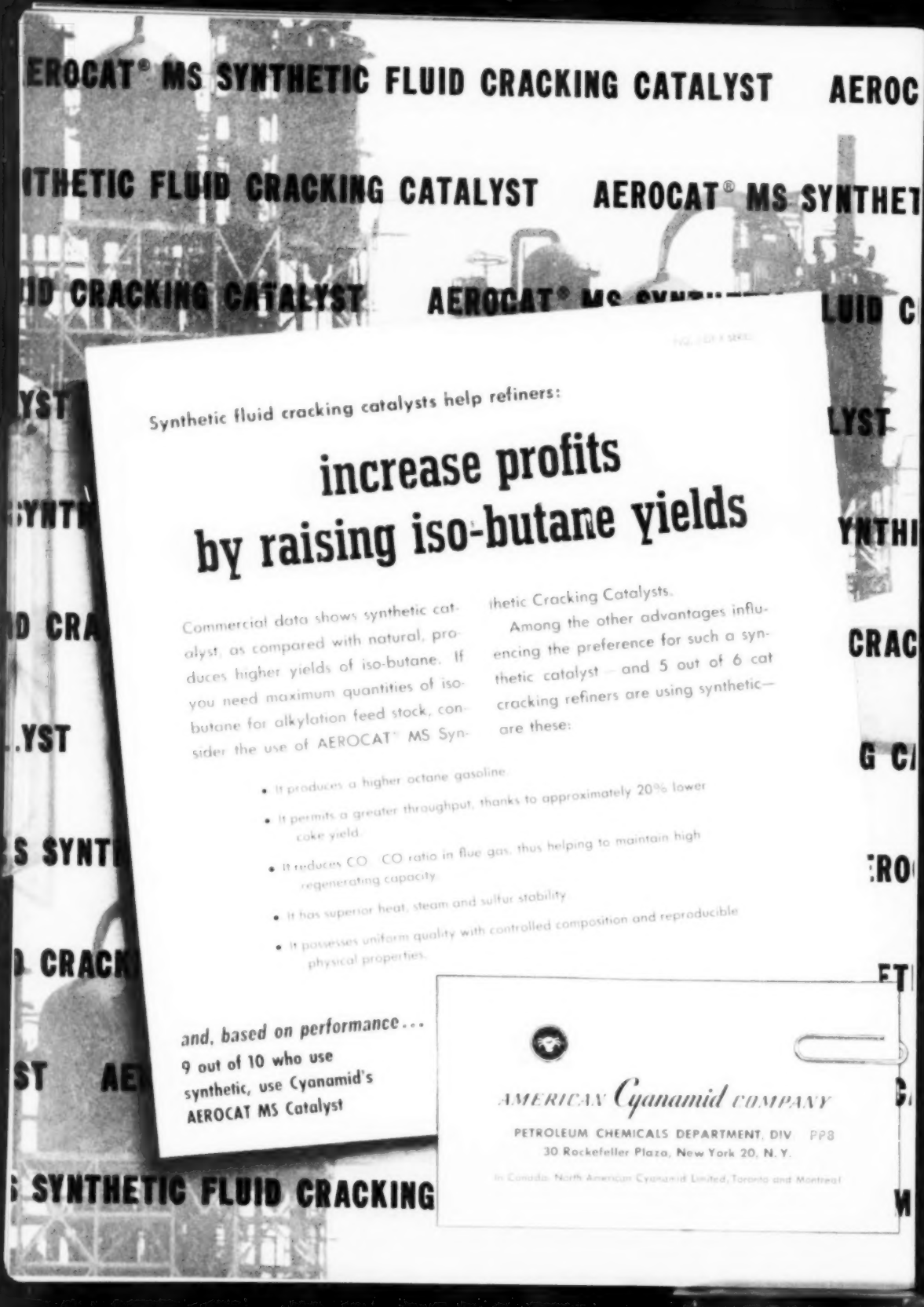
Certain manufactured gases, such as refinery still gas, oil cracking still gas, etc. contain high percentages (50-80%) of hydrogen, and it would be very advantageous to separate the hydrogen which diffuses through the boundary much faster than other constituents because of the much smaller diameter and mass of the hydrogen molecules.

The patent deals with a condensible vapor, such as steam, for use as the sweep gas. If the steam which diffuses through the boundary into the gas being refined is condensed in the diffusion zone, a substantially greater percentage of hydrogen may be separated by diffusion from the gas than if the steam is not condensed in the diffusion zone.

The equipment used is illustrated in the flow diagram at left. Gas to be refined is introduced through line 10 and through blower 12, which forces the gas through heating coil 18. The heated gas then flows through line 22 into distributor 24 mounted on top of gas chamber 26 of the diffusion apparatus. Chamber 26 is an annular unit positioned between cylinder 28 and cylindrical porous diffusion diaphragm 30. The gas flows downwardly through chamber 26 along the face of diaphragm 30, and the gas which does not pass through the diaphragm flows out of the bottom outlet 32.

The sweep medium (steam) introduced through line 34, is measured, and flows through heating coil 40 for superheating to prevent condensation within the diffusion zone. The steam flows through line 44 into the top of the steam chamber 46 of the diffusion apparatus, valve 47 being closed. Chamber 46 is an annular chamber located between diaphragm 30 and a central core 48 mounted in the central portion of the steam chamber.

The steam flows downwardly through chamber 46 in a concurrent direction with the flow of gas but upon the opposite side of the boundary 30 from the gas. As the steam and gas thus flow in a continuous stream along the face of boundary 30, there is a diffusion of the constituents of the gas and the steam through the boundary. Since the rate of diffusion is dependent upon the masses and molecular diameters of the constituents of the two gas streams, it is apparent that the con-



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stituent which has the smallest diameter and smaller mass will flow at a higher rate than the other gas constituents.

The temperature in sweep chamber 16 is controlled to prevent steam condensation. Also, an electrical heating coil 70 may be mounted on core 18 to maintain the desired temperature within the diffusion zone.

All of the steam, together with any gas which diffuses through boundary 30 that reaches the bottom of diaphragm 30, flows out of the bottom of chamber 16 through outlet 72, then into condenser 56 where the steam is condensed, while the remaining gas flows into receiver 58.

The gas flowing down through chamber 26 is cooled by water jacket 64 surrounding cylinder 28. The cooling is such as to condense all or part of the steam diffusing through boundary 30. This condensed steam flows with the gas to the bottom of chamber 26 and through outlet 32, thence through line 66 to receiver 68.

Patents Issued in June

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for June 3, 10, 17, and 24, Vol. 659, Nos. 1-4.

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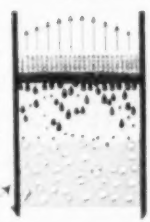

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(To obtain more data on advertised products see page 1192)

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Patents

2,566,891 (Phillips Petroleum Co.) Three-stage process for manufacture of reduced crude oil.

2,566,940 (Esso Research & Eng. Co.) Method of oxidizing acidic sulfur compounds of the type which occur in hydrocarbon oil in presence of dihydroxybenzene benzene.

2,566,971 (Texas American Refining Corp.) Hydrofluoric acid refining of hydrocarbon oils.

2,566,984 (Shell Dev. Corp.) Process for refining high boiling crude oils.

2,567,077 (Standard Oil Development Co.) Distillation of light hydrocarbons.

2,567,614 (Shell Development Co.) Liquid contact apparatus with rotating disks.

PRODUCTS

Chemicals

2,566,852 (Standard Oil Co. Ind.) Separation of organic esters.

2,566,249 (General Aniline & Film Corp.) Method of copolymerizing ethylene with butadiene.

2,566,462 (Allied Chemical & Dye Corp.) Separation of products obtained from isobutylene-sulfonyl chloride adduct.

2,566,503 (E. I. du Pont de Nemours & Co.) Reaction of phosphorus trioxide with monochlorocarbon monoxide copolymers.

2,566,544 (Phillips Petroleum Co.) Stabilization of desulfurized organic material-sulfur dioxide resins with elemental sulfur of inorganic sulfides.

2,566,616 (Celanese Corp. of America) Ageing and polymerizing impure methyl vinyl ketone.

2,566,797 (Shell Development Co.) Nitrogen-containing organic esters and their preparation.

2,566,813 (Phillips Petroleum Co.) Stabilization of sulfur-dioxide resins.

2,566,817 (Shell Development Co.) Carbo-polymerization homopolymers of unsaturated alcohol ethers of glycols and their homologs.

2,566,914 (Shell Development Co.) Process for preparing esters.

2,566,956 (Texas Service Oil Co.) Purification of organic acids.

2,566,967 (Phillips Petroleum Co.) Preparation of halosilane sulfonates and halosilane desulfonates thereof.

2,566,971 (General Electric Co.) Self-lubricated plastics for bearings containing molybdenum sulfide.

2,566,975 (Standard Oil Development Co.) Water-soluble surface active agents from olefin polymers.

2,566,994 (Sullivan, Jr.) Oxygenation of olefins using thiolated catalyst.

2,567,071 (E. I. du Pont de Nemours & Co.) Butadiene-cobalt carbonyl-halide adduct.

2,567,227 (Phillips Petroleum Co.) Method of making ferrous alkyl trihalocarbonates.

2,567,706 (Shell Development Co.) Hydrolysis of alpha-hydrocarbon-alpha, beta-dihalocarboxylic compounds.

2,567,788 (Socony-Vacuum Oil Co.) Esters of thiophene-modified maleic anhydride styrene copolymers and oil compositions containing the same.

2,567,802 (M. W. Kellogg Co.) Polymerization of olefin-carbon polymers.

2,567,804 (M. W. Kellogg Co.) Production of chlorinated olefin polymer in aqueous slurry.

2,567,821 (M. W. Kellogg Co.) Process for polymerizing trifluorochloroethylene.

2,567,826 (Socony-Vacuum Oil Co.) Thiaryl mercaptals and mercaptol.

2,567,922 (Jefferson Chemical Co.) Process of preparing olefin dihalides in the presence of an inhibitor for substitution reactions.

2,567,952 (Phillips Petroleum Co.) Producing an oil-resistant rubber from a non-oil-resistant rubber and a non-oil-resistant polymeric material.

2,567,971 (Shell Development Co.) Shortstopping the addition polymerization of unsaturated organic compounds.

Fuels

2,567,124 (Standard Oil Development Co.) Motor fuel containing tetrahydrofurfuryl alcohol.

2,567,205 (United Aircraft Corp.) Accelerant water injection control apparatus for internal-combustion engines.

2,567,113 (Standard Oil Development Co.) Motor fuel containing thio ether of carboxy acid.

2,567,122 (Phillips Petroleum Co.) Maintaining B.T.U. content of residue gas from absorber.

Lubricants

2,566,537 (Standard Oil Development Co.) Inhibiting oil gear inhibitors.

2,566,541 (Standard Oil Development Co.) New P-S containing compounds as corrosion inhibitors in oils.

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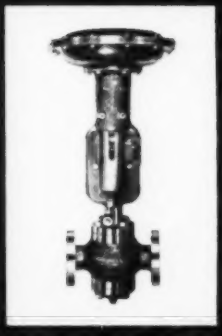

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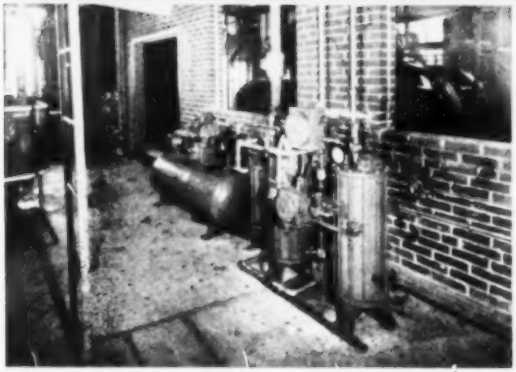
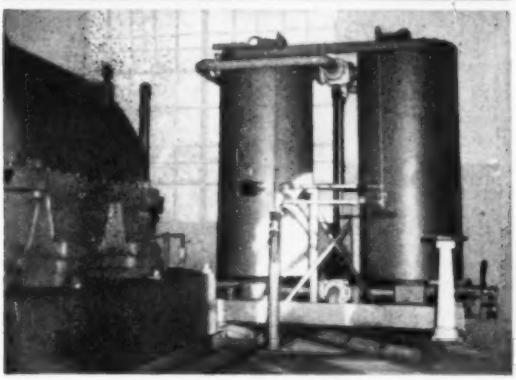


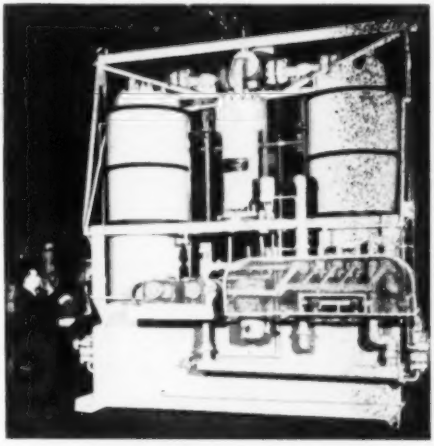
Instrument air controlling a city gas plant

Compressed air in this system controls and records the flow of butane to preheaters, where it vaporizes. The Lectrodryer* keeps that air DRY; no freeze-ups of lines or clogging of delicate instrument ports.



Butane standby for a metropolitan gas system

Manufactured gas used for forcing butane out of the barge tanks in which it arrives at the plant, and again for forcing it into the vaporizing equipment, is dried this Lectrodryer. Thus, there's no chance of moisture getting into the tanks.



Gases at 5,000 psi. in research work

A package unit, ready to run, but so big it had to be shipped on a depressed-bottom car. Yet this Lectrodryer only needed to be connected to feed lines and it was ready for action. Fully automatic, it reverses the DRYing-regenerating cycle at predetermined intervals.

Whatever your DRYing need—atmospheric or high pressure, small or large volume, manual or automatic control—Lectrodryer can handle the job. For DRYing help, write Pittsburgh Lectrodryer Corporation, 332 32nd Street, Pittsburgh 30, Pa.

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In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Brossaux-Liege.

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LECTRODRYER

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Oil and gas men know the importance of "bone dry" petroleum products. They also know that ALCOA *Activated* Alumina is one of the oldest . . . most reliable . . . thoroughly proved drying agents in the petroleum industry.

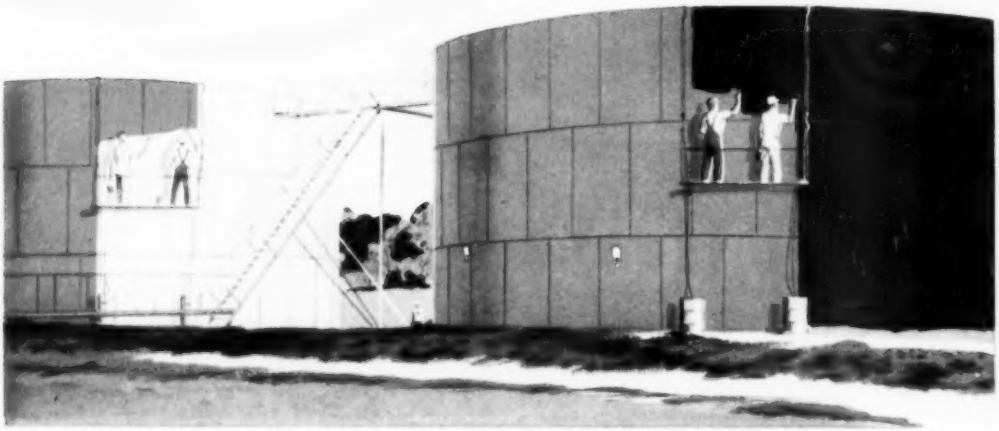
ALCOA *Activated* Alumina, earning its reputation the hard way, has *proved* its superiority, year-in, year-out, in hundreds of steady, reliable dehydration jobs. Particularly efficient in drying furnace oil and gasoline, instrument air and other gases, it has effectively solved the problems of moisture in finished products in storage or in pipe lines.

ALCOA *Activated* Alumina is highly adsorptive . . . easy to handle . . . abundantly available . . . and easily regenerated. It is one of the few desiccants that will not shatter on contact with water. It has high resistance to crushing, shock and abrasion. Moreover, this highly inert aluminum oxide dries to *lower dew points* than any other commercial adsorbent!

ALCOA *Activated* Alumina can speed up your processes . . . can save *your* money. Let us tell you how. Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 616-H Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA TELEVISION—CBS Network, 6:30 to 7:00 P.M. EDST every Sunday on most stations—8:30 to 9:00 P.M. in far West

IT TAKES *THESE TWO* TO KEEP THEM *NEW!*



Keeping costly crude oil tanks and other steel structures like new calls for finishes specially engineered to meet conditions encountered in petroleum service. Keeping maintenance costs down by need of fewer repaints is increasingly important, too. Many companies have found the answer to both with this two-step system that saves two ways.

Ask your Sherwin-Williams representative for data on these and others in the complete line of Sherwin-Williams Petroleum Industry Finishes. Or write, The Sherwin-Williams Co., Transportation Division, Cleveland 1, Ohio.

1 PRIME WITH S-W KROMIK®

. . . the heavy-duty, multiple-pigment primer. Kromik includes not only the best protective properties of red lead, but also those of three other protective pigments as well to effectively seal the metal against rust and corrosion.

Kromik penetrates cracks, joints, rivet holes. It covers evenly whether brushed or sprayed . . . weak spots that occur with heavy-pigmentation primers are avoided. It dries *through*, forming a tough, tight film that withstands weather and abrasion.

2 FINISH WITH S-W METALASTIC®

. . . a long-lasting finish coat with exceptional weathering characteristics. It possesses the water-shedding properties of carbon and graphite . . . provides a film that's tough and elastic to withstand contraction, expansion and the extremes of temperature and moisture. It is fast-drying, bringing the freshly-applied paint past the danger, of damage by rain, in the shortest time.

SHERWIN-WILLIAMS

PETROLEUM FINISHES

Union Oil Man Is No Tenderfoot

PISTOL PACKIN' LABMAN at Union Oil Co.'s Brea engine laboratory, **R. D. O'Connell** shoots .22, .38 and .45 pistols in tournaments as a hobby and has won trophies in California State Elks championship and regional matches this season. In eight years, Mr. O'Connell has collected many trophies and medals. Knives he holds were made by him, another hobby.

Warren H. Kraft, Honolulu Oil Corp., was elected president of the California Natural Gasoline Assn., succeeding **George C. McLaren**, Standard Oil of Calif.

Fred L. Hartley, Union Oil Co., was elected vice president, and **E. R. Millett, Jr.**, was reappointed secretary-treasurer.

Mr. Kraft

Mr. Hartley

Committee chairmen include: Mr. Hartley, advisory; R. E. Jenkins, Clark Bros. Co. Inc., entertainment; R. W. Heath, Signal Oil & Gas Co., fall meeting; M. L. Fort, Pacific Lighting Gas Supply Co., finance and budget; H. R. Linhart, Richfield Oil Corp., gas report; A. J. Sullivan, Standard of California, membership; Lloyd L. Jones, Connersville Blower Corp., program; J. H. Watson, Union, technical; and Mr. Millett, publicity.

* * *

Dr. Roy J. Plunkett, manager of Du Pont's Organic Chemicals Department, won the John Scott Award (originally $20, now $1000) for the discovery of polytetrafluoroethylene or "Teflon." Dr. Plunkett made his "chance discovery" in 1938 while working as a du Pont chemist in the development of new fluorine-containing refrigerants.

Dr. Plunkett received his B. S. in chemistry from Manchester College, Indiana, in 1932 and his Ph. D. from Ohio State University in 1936. After his discovery he was later assigned as chemical supervisor of Du Pont's tetraethyllead plant, and in 1945 was made TEL plant superintendent. In 1950 he became assistant manager of the Chambers Works and was promoted to his present position at the beginning of this year.

* * *

Cecil C. Wuth has succeeded **R. R. (Russ) Bacon** as chief engineer of the Shell Oil Co. refinery at Martinez, Calif. Mr. Bacon has been named assistant chief engineer in the manufacturing department home office, New York.

Mr. Wuth, who started with Shell at Martinez in 1929, recently completed an overseas assignment as engineer in charge of major field construction at Stanlow refinery, England. Prior to that, he was assistant chief engineer at the Wilmington (Calif.) refinery. Mr. Bacon, too, recently completed a special 12-month assignment in England.

* * *

Byron R. Johnstone has been elected secretary of the American Petrochemical Corp. by the board of directors. **John D. Snakenberg** was appointed plant manager. Engineering plans for American Petrochemical have been under way for several months and are now complete. Site of the plant will be somewhere on the Gulf Coast.

Mr. Johnstone

Mr. Snakenberg

Mr. Johnstone has been with the Cities Service organization since 1928, the last five years as secretary of Cities Service Research and Development Co. Mr. Snakenberg has been with the organization since 1923 and was manager of the Cities Service East Chicago refinery from 1947 to 1950. Since 1950 he has been associated with Cities Service Petroleum Inc., New York, as assistant chief engineer in the manufacturing division.

* * *

Virgil B. Guthrie has been named Eastern Editorial Director of the Platt Petroleum Publications with headquarters in New York. Mr. Guthrie, a member of the Platt organization since 1915 when he began as the first reporter for *National Petroleum News*, is now associate editor of that publication, and editor of PETROLEUM Processing.

In his new capacity Mr. Guthrie will coordinate all editorial activities of the two publications and of Platt's *Oilgram News* and *Price Service* in the East.

* * *

Kenneth Borah, of the products application department at Shell Oil Co.'s Wood River refinery, has been appointed lubrication engineer for the five Shell refineries. He will headquarter at Wood River and assist the refineries on equipment lubrication problems.

Other Shell appointments include

J. G. Wilson to chief engineer of the West River refinery replacing **J. C. Goldsberry**, who has been transferred to the head office engineering department as senior engineer on special assignments. Mr. Wilson was formerly assistant manager in charge of refinery process and design activities in the head office engineering department.

* * *

Humble Oil and Refining Co. has made the following additions to its staff at Baytown, Tex.: **C. C. Harlin, Jr.**, who holds an M. S. in civil engineering from Texas A. and M. College, to the maintenance engineering and inspection department, and **T. B. Brister**, to the engineering division. Mr. Brister is a mechanical engineering graduate from Mississippi State College.

* * *

Turner C. Smith, General Petroleum's chief structural engineer, with offices in Los Angeles, has gone to Caracas, Venezuela on a special assignment as consultant on the design of a building to be erected by the Socony-Vacuum Oil Co. of Venezuela, an affiliate of Socony-Vacuum Oil Co. Mr. Smith, accompanied by his wife, expected to stay in Caracas four or five months.

Stewart S. Kurtz has been appointed technical associate in Sun Oil Co.'s research and development department. He will move to department headquarters at Marcus Hook, Pa., as a staff assistant to **Dr. J. Bennett Hill**, director of the chemical and engineering division. In addition to handling technical matters in his specialized fields, Mr. Kurtz will represent Sun in various scientific and technical organizations outside the company.

Mr. Kurtz

Since 1942 Mr. Kurtz has served as manager of the company's chemical research laboratory at Norwood, Pa. He will be succeeded in this position by **Dr. C. L. Thomas**.

Mr. Kurtz received undergraduate and graduate degrees from Harvard University and joined Sun's research staff as a chemist in 1935. He is a winner of the Franklin Institute's Louis Edward Levy Gold Medal for his publications on refractive index. He was chairman of the American Chemical Society's Petroleum Division in 1945-46.

* * *

Vincent M. Norwood has been appointed manager of Canadian Oil Companies Ltd. Sarnia refinery. He was formerly general superintendent of the Petrolia refinery, a position he achieved through a series of promotions dating to 1941. He graduated from the University of Toronto in 1935 with a degree of B. A. Sc. in chemical engineering and joined the staff of the refinery at Petrolia in charge of instrument maintenance in 1936.

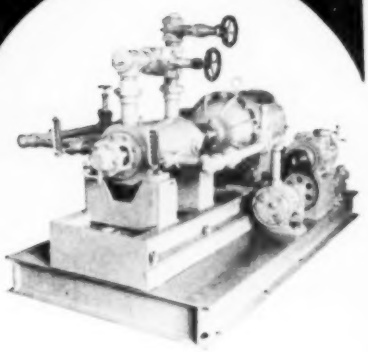
* * *

Recent promotions and transfers involving 15 members of the Refinery Engineering Division of Socony-Vacuum Oil Co. Inc. include:

R. E. Redfield, manager of manufacturing for Socony-Vacuum France, will return to the United States in August to become head of the maintenance group, and **Austin C. Brightman**, assistant chief project engineer has been advanced to project engineer, and **Edward T. Maples**, a group leader, will become assistant chief project engineer; **Norman Lockwood**, head of maintenance at Socony-Vacuum's Brooklyn refinery, has been transferred to the Refinery Engineer-

the Turbinizer

for continuous production of complete dispersions or emulsions



It's unique — operates on principle of hydraulic shear — requires no close operating clearances — has no contacting surfaces to wear out.

It's fast — produces thorough dispersions at up to 5000 gals. hr.

It's versatile — handles anything pumpable — liquids, powdered solids or gases — including component materials of widely different viscosities.

It's flexible — can be used for blending, dissolving, dispersing, emulsifying, extracting, reacting, scrubbing and homogenizing.

It's adaptable — can be easily piped for controlled recirculation or pre-discharge dilution.

It's compact — unit and auxiliary equipment mounts on single base.

It's precise — can be jacketed for close temperature control and otherwise fully instrumentated.

It's simple — no close adjustments need be made or maintained — no special operator training required.

It's quiet — despite high speed it's almost vibrationless in operation.

It's easily cleaned — quickly drains free — "hold-up" ranges from 1 quart to 1 gallon — wastage is extremely low.

It's economical — the lack of close clearance, the abrasion resistance of moving parts, the rugged construction minimize wear and repair.

Write for details, today

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PROCESS EQUIPMENT DIVISION
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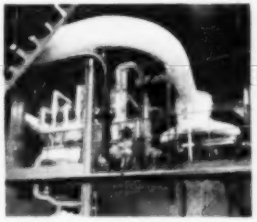
Carey insulation products were chosen for Arapahoe on the strength of their proven ability to meet economically all requirements for strength, lightweight, dimensional stability and performance on a wide range of equipment, operating at temperatures to 1600° F.

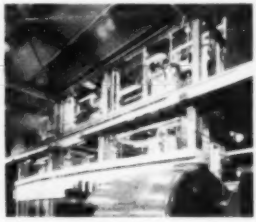
Development and manufacture of products for heat conservation has been an important Carey service to industry since 1873. That's why we believe we can solve your heat conservation problem no matter how unusual it may be. The Carey line includes new, monolithic Super Light 850 magnesia in molded pipe coverings, blocks and cements—now being manufactured in our new, multi-million dollar plant. This material is light weight, strong, easy to handle, easy to apply. It will not disintegrate or crack under normal service conditions and can be removed and reapplied, when necessary.

Call on Carey for the solution to your heat conservation problems. Use the coupon to request the latest bulletins describing uses for Carey insulation products. If you wish, the coupon will also enlist for you the services of a qualified Carey Industrial Sales Engineer. No obligation.

• In the boiler feed pump room, feed-water discharge lines and recirculating lines are insulated with 2" thick Carey 85% magnesia insulation. Finish is 8 oz. canvas on resin sized paper. Boiler feed water suction lines insulated with Carey standard thickness 85% magnesia, finished with 8 oz. canvas over resin sized paper.



• The main steam lines and stop valve to turbine, where operating temperatures reach a maximum of 905° F. 8" and 12" pipe, insulated with 2" thick Carey Hi-Temp. and 2" thick Carey 85% magnesia, finished with ½" Carey asbestos cement, layer of asbestos paper, layer of asbestos cloth sewn on with copper wire.



• View of Arapahoe Station from turbine floor. Elevation 5087. Workmen are applying 8 oz. canvas to lines.

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In Canada: The Philip Carey Co., Ltd., 277 Duke St., Montreal 3, P. Q.

ing Division as a project engineer. **Vernon Loyd**, in charge of maintenance at the East Chicago, Ind., refinery, transferred to the Refinery Engineering Division as senior engineer in the maintenance section. **Robert J. Timmons** has been promoted to head of the operating group, and **William G. Hard** has become his assistant. **Urban H. Wagner**, senior process engineer, has joined the company's refining coordination department in New York as assistant chief process engineer. **James P. Shamhaugh**, head of the process promotion section, has been transferred to the process promotion section of the research and development department in New York to assist **A. V. Danner** in handling licensing activities of the company.

* * *

On special leave from Shell Oil Co. since 1950, serving with the Petroleum Administration for Defense in Washington, **B. W. Dunbar** returned to the company and was appointed manager of the catalytic cracking department of the Wood River refinery. He was formerly senior technologist in the head office technological department.

* * *

E. R. Baker has been promoted to manager of Continental Oil Co.'s research and development department with headquarters in Ponca City, Okla. He succeeds **L. L. Davis** who is retiring after 25 years of service; however, Mr. Davis will continue to serve the company in a consulting capacity.

Mr. Baker

Mr. Baker joined Continental at Ponca City in 1918 as manager of the company's central research and development last year. Prior to joining Continental he was associated with several eastern firms. He received his B. S. in chemistry from Yale University in 1929, and studied three subsequent years in the Yale graduate school. In 1939 he was graduated from the Suffolk Law School of Boston, and admitted to the Massachusetts bar.

* * *

Cecil L. Burrill will head Creole Petroleum Corp.'s New York office Sept. 1, replacing **Lloyd G. Smith**, vice president and director. Mr. Smith will devote his time to refining problems until his retirement. Mr. Burrill has recently completed 18 months as Petroleum Administration for Defense division director.

* * *

J. N. Wilson has been named head of the catalysis and surface chemistry department of the Shell Development Co., with offices at Emeryville, Calif. Formerly head of the physics department, Mr. Wilson has been succeeded to that post by his assistant, **D. P. Stevenson**.

* * *

Boris L. Bodzianko, who transferred from Socony-Vacuum to General Petroleum as a refinery engineer in 1944, has been raised to the status of senior refinery engineer at GP's Torrance, Calif. refinery.

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New Assistant Sales Manager

Mr. Kingerley

A. S. Kingerley has been named assistant Midwestern sales manager of the Wolverine Tube Division of Calumet and Hecla Consolidated Copper Co. He has held various sales positions with the company since joining their ranks in 1927. In his new position, Mr. Kingerley's jurisdiction will cover sales in Michigan, northern Ohio, and a portion of Indiana. His headquarters will be in the company's general sales offices, 1850 Guardian Bldg., Detroit 26, Mich.

Stockham Buys Wedgeplug

After considerable negotiations, Stockham Valves and Fittings Co. of Birmingham, Ala., purchased the Wedgeplug Valve Co. Inc. of New Orleans, La., which will continue to operate as a separate corporation. New directors of the company are Leo P. McCurnin and Christian Nielsen, of the original Wedgeplug board, and Tom B. Noble, Douglas Stockham, and Richard J. Stockham.

Wedgeplug, like Stockham, had a small beginning but now has its products distributed throughout North America, Canada and countries abroad. Officials believe the move will increase sales of both Stockham and Wedgeplug products.

Wedgeplug valves will be distributed through the Stockham sales organization and their jobbers. The valves will be carried in Stockham warehouses in Birmingham, Philadelphia, Chicago, Houston and Los Angeles as well as at Wedgeplug in New Orleans.

Kewanee and Ross Combine

Kewanee Boiler Corp. and Ross Heater & Mfg. Co. Inc., two divisions of American Radiator & Standard Sanitary Corp., have combined to form a new company, Kewanee-Ross Corp. Charles H. Currier, formerly president of Ross Heater, has been named chairman of the board, and W. Bradford Russel, formerly president of Kewanee Boiler, is president of the new firm.

Kewanee is a manufacturer of steel heating and power boilers with plants at Kewanee, Ill., and Lebanon, Pa. Ross Heater are manufacturers of shell and tube heat exchangers with offices and plant in Buffalo, N. Y. The unification of the management, personnel and facilities of the two firms is expected to provide a broader scope of operations than was possible before with a wider range of related products and services.

Named Construction Manager

C. L. Hoshaw has been named manager of construction for the Philip Carey Mfg. Co., Cincinnati. In 1937 he joined Carey as an estimator, later becoming contract manager in Indianapolis. In his new capacity, Mr. Hoshaw will oversee insulation and built-up roofing contract units.

Mr. Hoshaw

Mr. Hoshaw received his engineering education at Purdue University and has been affiliated with Adams-Westlake Co., Bendix Aviation Corp. and the Carrier Corp. He is a member of the American Society of Heating and Ventilating Engineers, the Masonic Lodge and Delta Upsilon fraternity.

Fluor Appointments

Mel Ellsworth, head of the Tulsa sales office of the Fluor Corp., has been appointed vice president in charge of Mid-Continent sales, continuing his headquarters in Tulsa.

Art Whistler has succeeded Lee Van Horn as chief process engineer following Mr. Van Horn's appointment as vice president in charge of research and development for Fluor. Mr. Whistler will headquarter in Los Angeles.

Mitch Washburn, Pasadena, Calif., and David Tappan, Jr., San Mateo, Calif., have been appointed as assistants to the vice presidents in engineering and sales with headquarters in Fluor's home office, Los Angeles.

Rovang Installs Northwest Mill

W. G. Rovang Inc. has installed the first continuous tube mill in the Northwest at 1945 N. Columbia Blvd., Portland, Ore. The company is now making both stainless and aluminum tubing. The new mill will make continuous tubing from 1-in. to 4½-in. sizes, with wall thickness from 18 gauge to ¼-in. Operation includes former, fully automatic inert gas welder and pressure testing equipment. J. B. Nicholson will be in charge of sales and planning for the tube division of the firm.

Sales Appointments At Graver

Graver Water Conditioning Co. has appointed Harold R. Fosnot as assistant general sales manager, and Leonard Limon as manager, sales engineering department.

Mr. Fosnot was employed by Graver in 1935. After a thorough training in the Graver shops at East Chicago, Ind., he was named district manager in the sale of fabricated steel and water conditioning equipment until World War II, when he entered the U. S. Army as a Lieutenant Colonel. He returned to Graver after the war and continued to serve as district manager of water conditioning sales until 1951. He was then made Eastern district sales manager, headquartered in New York. Mr. Fosnot holds the degrees of B. S. M. E. from Purdue University and M. B. A. from the University of Chicago.

Mr. Limon came to Graver in 1949 as supervisor of the estimating department. Before joining the company he had many years of experience as executive in charge of the design, estimating and pricing of all types of water conditioning equipment. His new position will find him in charge of the sales engineering department which, in addition to the function of estimating, will also include preliminary engineering design. Mr. Limon holds a B. Ch. E. from City College of New York and M. Ch. E. from New York University.

W. K. Menke Takes New Post

W. Kenneth Menke has been elected to the newly created post of vice president in charge of chemicals with Pittsburgh Coke & Chemical Co. He will be in charge of the general administrative duties of the company's expanding chemical activities.

Before joining the company, Mr. Menke had been with Monsanto Chemical Co. for 17 years in various operating, research and administrative positions, the most recent having been director of the development department. Mr. Menke received his degrees in chemistry and chemical engineering from Washington University, St. Louis, Mo.

Acquire Berkeley Scientific

Berkeley Scientific Corp., electronics firm with a plant in Richmond, Calif., has been acquired by Beckman Instruments, Inc., South Pasadena, Calif., manufacturers of scientific instruments.

W. K. Rosenberry, president of the Berkeley Scientific Corp., has been named vice president of the Beckman company and will continue to direct operations of the Berkeley division.

Production capacity for the Berkeley firm's line of electronic counting

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You get a lot of plus values . . . and avoid a lot of failure headaches and possible accidents . . . by using Jerguson Flat Glass Gages for every liquid level indicating use.

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Jerguson Flat Glass Gages save money and labor. They are easy to install. They stand up . . . you don't have to keep servicing them or replacing the glass. They are available in a wide range of sizes, pressures, designs and materials; also with polished end stems to replace present tubular gages.

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devices and related equipment will be tripled, company stated.

Worthington Names Director

Ralph M. Watson has been named director of research for Worthington Corp., succeeding Paul Diserens who has retired. Mr. Watson has been with the Worthington organization since 1936, at that time until 1942 as an engineer in the refinery pumps section of the centrifugal pump division. From 1942 to 1945 he was chief engineer of that division and in 1945 was named assistant to the vice president in charge of engineering.

Mr. Watson

Mr. Watson is a mechanical engineering graduate of California Institute of Technology, and also holds an M. S. from Cal. Tech. He is a member of the American Society of Mechanical Engineers, a member of the Power Test Code Committee on centrifugal pumps.

Davison Promotes Ralph Hope

Ralph E. Hope has been appointed manager of research engineering of the Davison Chemical Corp., Baltimore. For the last two years, Mr. Hope has been Davison's representative at Warrington, England, on the design and operation of a plant built by an affiliate of Lever Brothers & Unilever Ltd., for the production of petroleum cracking catalyst by the Davison microspheroidal process.

Mr. Hope

Prior to assignment in England, Mr. Hope was plant engineer at the company's Cincinnati catalyst plant. He studied mechanical engineering at the University of Cincinnati and did graduate work in chemical engineering at the University of Michigan.

Buys Jackson Engineering Co.

Drayer-Hanson Inc., Los Angeles, Calif., manufacturers of air conditioning and refrigeration equipment, has completed the purchase of the Jackson Engineering Co., Montebello, Calif., producers of aerial coolers and shell and tube heat exchangers for the petroleum and chemical industries. Gordon M. Jackson joins Drayer-Hanson as vice president of the industrial division. He will have charge of the mechanical design, selection and sales engineering of all heat transfer equipment offered for use in engine cooling systems, gasoline refineries, power plants and other industrial applications. The purchase involves the exchange of approximately 30,000 shares of Drayer-Hanson common stock.

The company will take advantage of Jackson's experience in the manufacture of helically wound finned tubing to produce "Cal-Fin" tubing, formerly made by Cal-Fin Co. This product will be used not only in aerial coolers, but also in a new line of Drayer-Hanson copper finned steam and water coils.

Rector Joins Walco

Norman K. Rector has filled the position of chief design and process engineer with Walco Engineering & Construction Co., Tulsa. From 1950 until joining Walco, Mr. Rector worked as an independent consulting engineer in the natural gasoline plant field. Included in his earlier experience is work with Petroleum Engineering Inc., in Tulsa and Houston, and the Gregg-Tex Gasoline Corp. of Longview, Tex.

Mr. Rector

After completing his engineering studies at Oklahoma A. & M. College, Mr. Rector got his start in the petroleum industry with the Marland Oil Co. at Ponca City in 1926.

Personnel Changes

American Cyanamid Co. — E. W. Koffman named to assist in the sale of products of the Petroleum Chemical Dept., New York district office, devoting some time to the sale of the Industrial Chemical Div.'s line in southern New York State.

Ethyl Corp. Matthew A. Taylor appointed manager of sales operations. Mr. Taylor was formerly assistant manager of the Eastern sales region.

Black, Sivalls & Bryson Inc. — Paul Bartley named assistant regional manager for the Gulf Coast; L. E. Jones named assistant regional manager covering the Houston and Alice branches in the Gulf Coast area; appointed assistant West Texas Regional managers are Ed Pool to supervise the Odessa, Hobbs and Farmington

branches, and Ed Reif to head branch operations in Lubbock, Snyder and Graham.

E. I. du Pont de Nemours & Co. — R. W. Malcolmson named technical representative in the Southwest with headquarters in Houston. He will provide the petroleum industry with aid in the development of rubber products for service in the oil fields and refineries of the region.

Carbide and Carbon Chemicals Co. — John Conway, J. A. Field, and W. A. Woodcock named assistant managers to R. L. Bateman, manager of the company's Fine Chemicals Division.

Rockwell Manufacturing Co. — Charles C. Reiff appointed chief engineer of the company's Barberton Division, Barberton, Ohio; Bernard Last succeeds him as project engineer of the lubrication department in Pittsburgh.

Metal Goods Corp. — Charles G. Gribble, Jr., appointed to manager of sales, Houston Division.

Beckman Instruments Inc. — Dr. Robert Austin joins the company as a specialist in the development of titration instruments. He was formerly associated with Consolidated Engrg. Corp.

American Meter Co. — John D. Van Norden becomes sales representative in the Atlanta territory. He was formerly associated with United Engineering and Constructors Inc.

Foster D. Snell Inc. — Walter L. Hardy named director of package engineering in the company's newly established Package Engineering Division.

Blaw-Knox Co. — Marvin M. Ramer promoted to contract manager at the Southwest Division of the Chemical Plants Division, in Tulsa, Okla.

Expansion, Transition

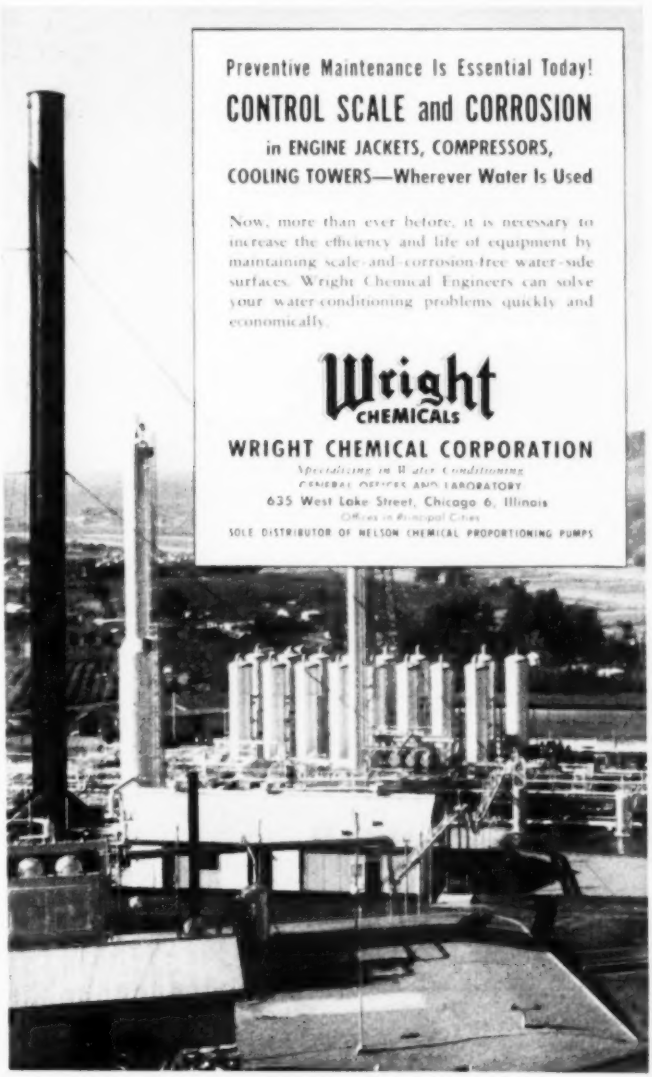
Petro-Chem Development Co. Inc., have moved to new and larger offices in the Chanin Building, 122 E. 42nd St., New York City.

Calumet & Hecla Consolidated Copper Co., has named C. H. Kuthe to manager of a new technical sales unit of the Wolverine Tube division, created to render technical service on problems particularly related to heat transfer and product fabrication. Mr. Kuthe will be assisted by L. J. Bonacor, R. B. Davis, and H. C. Flesch. Headquarters of the new unit are in the company's general sales offices at the Guardian Bldg. in Detroit.

Blaw-Knox Co. is increasing the scope of its West Coast office by providing sales representation for the services of the Chemical Plants division, and the products of the Process Equipment and Gas Conditioning departments. Under the management of J. P. Cullen, offices are located in the Monadnock Bldg. in San Francisco.

R. S. Aries & Associates, New York, chemical engineers and economists have established a Southwest regional office at 211 Brightwind Place, San Antonio, Tex., for coordinating Aries consulting work in the area. Alden H. Waitt, vice president, will direct the operations of the new office.

Conoflow Corp., manufacturers of pneumatic control equipment, has appointed Bruce Greaves Co. to handle "Cono Controls" in the St. Louis territory, which covers the eastern part of Missouri and southwestern Illinois. The Bruce Greaves Co. are specialists in instrumentation and industrial power equipment.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Unsolved Petroleum Industry Problems To Be Discussed at ACS Symposium

A SYMPOSIUM on "The Unsolved Problems of the Petroleum Industry" will highlight the program of the Division of Petroleum Chemistry during the American Chemical Society's 122nd national meeting in Atlantic City, N. J., Sept. 14-19. Dr. W. A. Gruse of Mellon Institute, Pittsburgh, will direct the symposium.

Seven sessions have been planned tentatively for the Petroleum Division. A second symposium has been placed on the program. It is entitled "Catalysis in Hydrocarbon Chemistry," and R. S. Greensfelder, Shell Development Co., Emeryville, Calif., will preside as chairman for this session.

The Hotel Traymore will be general headquarters for the Society, but most of the divisional meetings will be held in the Convention Hall.

Prospects for the expansion of the chemical industry in the Middle Atlantic area will be discussed in a symposium of the Division of Industrial and Engineering Chemistry under the direction of Dr. Arthur B. Hersberger, manager of the chemical products division, Atlantic Refining Co., Philadelphia.

Symposia will also be held by the Division of Analytical Chemistry on accuracy in analytical work; by the Division of Cellulose Chemistry on the size of cellulose molecules; by the Division of Gas and Fuel Chemistry on combustion; and by the Division of Organic Chemistry on organic phosphorous.

An exhibit of books on chemistry, excursions to chemical plants in the vicinity, and a special program for women chemists are planned.

Instrument Conference Has Full Technical Program

WITH 25 technical sessions for the Instrument Society of America alone, plus at least six sessions scheduled so far by the various co-operating societies, the 7th National Instrument Conference and Exhibit in Cleveland Sept. 8-12 promises to be the largest ever held. Attendance of over 10,000 is anticipated.

ISA sessions of interest to petroleum and petrochemical processors will cover the following broad classifications, according to the tentative program: instrumentation for production processes, 5 sessions, 16 papers; analysis instrumentation, 2 sessions, 6 papers; instrumentation for testing, 6 sessions, 25 papers; operation and maintenance, 2 sessions, 11 papers.

In addition, other sessions will be conducted by the ISA, American Society of Mechanical Engineers, American Institute of Electrical Engineers, etc., on instrumentation in such fields as aeronautics, medicine, high pressure measurements, geophysics, meteorology, and radiation.

The entire affair will take place in Cleveland's Public Auditorium. Two exhibition floors will be filled with displays by 178 commercial instrument manufacturers as well as A&M College of Texas, Case Institute of Technology, National Bureau of Standards, National Advisory Committee for Aeronautics, U. S. Geological Survey, Scientific Apparatus Makers Ass'n., and other co-operating groups.

AIChE Will Participate In Centennial Celebration

THE Centennial of Engineering in the United States will be celebrated from Sept. 3-13, 1952 in Chicago. Although actually commemorating the founding of the Civil Engineering Society, over 60,000 engineers of all types are expected to take part in the proceedings.

The American Institute of Chemical Engineers, scheduled to start their own program on Thursday Sept. 11 in the Palmer House, will participate in one of the broad survey meetings to be held Monday Sept. 9 as part of the general engineering convocation. A symposium, headed by Francis J. Curtis, vice president of the Monsanto Chemical Co., entitled "Chemical Industries," will be presented with papers on specific industries and economic conditions throughout the whole country.

The program to date: S. D. Kirkpatrick, vice president, McGraw-Hill Book Co., "Definition—Importance of Chemical Industries"; W. K. Lewis, Massachusetts Institute of Technology, "Chemical Engineering—A New Science"; William T. Nichols, vice president, AIChE and director of general engineering, Monsanto Chemical Co., "Industrial Chemicals, Inorganic"; H. E. Thompson, vice president, Union Carbide and Carbon Co., "Industrial Chemicals, Organic"; Randolph T. Major, vice president, Merck & Co., Inc., "Drugs and Medicines"; Eger V. Murphree, president, Standard Oil Development Co., "Petroleum"; F. C. McGrew, assistant research director, Du Pont Co., Inc., "Plastics"; J. R. Quig, manager, textile research division, Du Pont Co., Inc., "Fibers."

Donald A. Dahlstrom, assistant professor of chemical engineering at The Technological Institute, Northwestern University, has supervised the AIChE technical program.

One outstanding paper to be presented to the AIChE during one of their regularly scheduled sessions will be "The Fluidized Solids Technique in the Petroleum Industry," by Robert C. Gunness, assistant general manager of manufacturing, Standard Oil Co. (Ind.). Applications to catalytic cracking, hydrocarbon synthesis, oxidation reactions, and hydroforming are to be covered.

NPA To Celebrate Golden Anniversary

THE National Petroleum Assn. will celebrate their Golden Anniversary in Atlantic City's Traymore Hotel from Sept. 10 to 12. Main session of the anniversary meeting will convene the afternoon of Sept. 10, after preliminary morning meetings. T. O. Yntema, vice president in charge of finance, Ford Motor Co., will deliver the opening address with Earl Craig, president of Freedom-Valvoline Oil Co., presiding. The "Oil Timers Hour" will be held after the address, presided over by Harry Logan, United Refining Co. Donald C. O'Hara, NPA attorney, will conclude the day's events recounting the organization's 50-year history.

Thursday, Sept. 11, schedules a symposium on jet fuels: "Today and Future." Participating will be Dr. Carl Kelly, munitions board; Maurice Granville, assistant director of refining for Petroleum Administration for Defense; William Krause, Globe Oil & Refining Co.; Dr. J. B. Hill, Sun Oil Co.; and representatives, yet to be named, from Pratt and Whitney, General Electric and Bendix.

Thursday's meeting will close with an address to the general session by the president-elect and a spokesman of the steel industry, yet to be named.

Lubrication Developments On ASLE Program

DR. A. Bondi, Chemist, Shell Development Co. will take part in the discussion on the "Historical Development of Modern Lubrication Concepts" at the American Society of Lubrication Engineers' First National Symposium on "The Fundamentals of Friction and Lubrication in Engineering." Designated as the Victor A. Ryan Memorial Symposium, the meeting is to be held Sept. 8 and 9 at the Hotel Sherman, Chicago.

Prof. D. D. Fuller, department of mechanical engineering at Columbia University, will preside as discussion leader for the first session on Sept. 8 at 10 A.M., the one in which Dr. Bondi will participate.

Other sessions will cover: "Fundamentals of Hydrodynamic Lubrication," Sept. 8 at 2 P.M.; "Physics and Chemistry of Rubbing Solids — Basic Principles," Sept. 9 at 9 A.M. with Dr. R. G. Larsen, head of lubricants and gasoline department, Shell Development Co., as discussion leader; and "Physics and Chemistry of Rubbing Solids—Technical Applications," in the final session at 1:30 P.M.

M.I.T. Is Host To Combustion Symposium

PLANS are substantially complete for the International Symposium on Combustion to be held at the Massachusetts Institute of Technology, Sept. 1-5. Over 100 papers have been submitted for the symposium and are now being reviewed by the committee. Typical fields in which papers will be presented are ignition, stabilization in laminar and turbulent flow, limits of inflammability and detonability, instability phenomena, microstructure of combustion waves, theory of flame propagation, flame-jet structures, and combustion processes in rocket systems.

More than 50 representatives of Great Britain, France, Germany, Holland, Belgium, Italy, and Japan have already indicated their intention to attend the symposium. With experts from Canada and the United States, the symposium presents the opportunity for discussion of mutual problems in the combustion field.

Requests for registration forms or for further information should be addressed to Prof. Hoyt C. Hottel, Professor of Fuel Engineering at M. I. T., Cambridge 39, Mass. Prof. Hottel is co-chairman of the symposium.

Oil Man's Calendar

SEPTEMBER

International Symposium on Combustion, Massachusetts Institute of Technology, Cambridge, Mass., Sept. 1-5.

Rocky Mountain Oil & Gas Assn., refining committee, Newhouse Hotel, Salt Lake City, Utah, Sept. 4-5.

American Society of Lubrication Engineers, First National Symposium on The Fundamentals of Friction and Lubrication in Engineering, Hotel Sherman, Chicago, Ill., Sept. 8.

Instrument Society of America, annual conference and exhibit, Cleveland, Ohio, Sept. 8-12.

American Society of Mechanical Engineers, Industrial Instruments & Regulators Div., annual meeting, Cleveland, Ohio, Sept. 8-12.

Seventh National Chemical Exposition, Coliseum, Chicago, Ill., Sept. 8-13.

American Society for Testing Materials, committee on standards, Chicago, Ill., Sept. 10-11.

National Petroleum Assn., fall directors meeting, The Traymore Hotel, Atlantic City, N. J., Sept. 10-12.

American Institute of Chemical Engineers, Parlor House, Chicago, Ill., Sept. 11-13.

American Chemical Society, 122nd national meeting, The Traymore Hotel, Atlantic City, N. J., Sept. 14-19.

American Society of Mechanical Engineers, Petroleum Div., annual conference on petroleum mechanical engineering, Hotel Muehlebach, Kansas City, Mo., Sept. 22-24.

Western Petroleum Refiners Assn., 15th regional meeting, Herring Hotel, Casper, Wyo., Sept. 25-26.

OCTOBER

Scientific Apparatus Makers Assn., Rocky Mountain Section, midyear meeting, Denver Country Club, Denver, Colo.

National Assn. of Corrosion Engineers, South Central Region, Jung Hotel, New Orleans, La., Oct. 1-3.

California Natural Gasoline Assn., annual meeting, Ambassador Hotel, Los Angeles, Calif., Oct. 6-10.

Oil Progress Week, sponsored by the Industry Information Committee of the American Petroleum Institute, Oct. 12-18.

Industrial Packaging and Materials Handling Exposition, Chicago Coliseum, Chicago, Ill., Oct. 13-17.

American Institute of Electrical Engineers, Fall general meeting, New Orleans, La., Oct. 13-17.

Western Petroleum Refiners Assn., annual technical and industrial services meeting, Garrett Hotel, El Dorado, Ark., Oct. 16-17.

National Gasoline Assn. of America, Southern regional meeting, The Blackstone Hotel, Tyler, Tex., Oct. 19.

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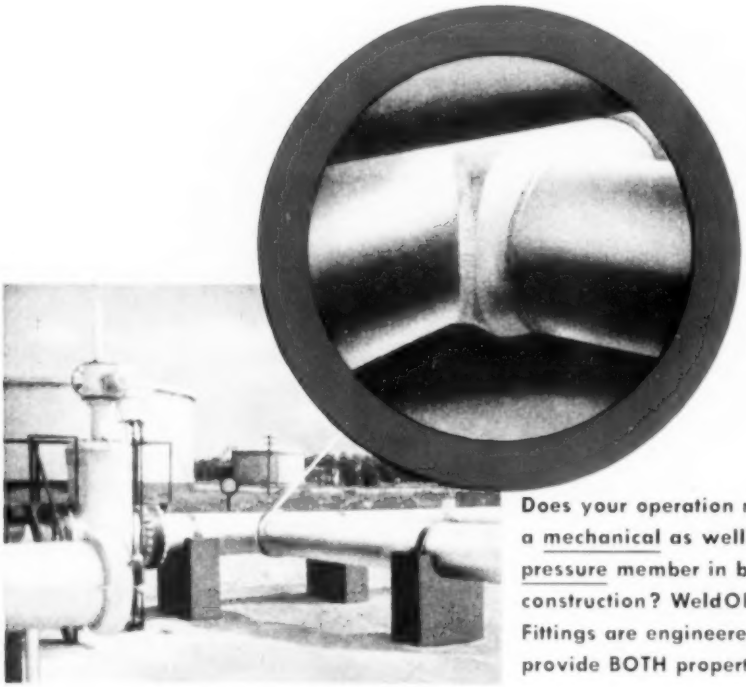

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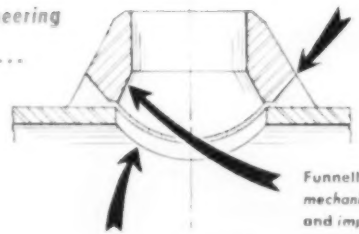

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Authors Use Simple Analogies To Explain Feedback Control

Automatic Feedback Control, by William R. Ahrendt and John F. Taplin. 6 x 9 in., xii + 412 pages, illustrated, indexed, stiff cloth binding. McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. $7.50

Engineers, teachers, technical men, and students will all benefit in their study of automatic feedback control systems by securing this book and carefully examining its contents. The authors have done a commendable job in exerting every effort in "getting across" their subject matter to the reader.

The introductory chapter rates high. Why? Not because of its detailed scientific content (that comes later), but because of its good "common sense" content. The analogies used comparing automatic feedback control systems in industry to such ordinary functions as driving a car, and the thermostat control in homeoperation of the ordinary house furnace, help to clarify just what automatic feedback control is. The material in subsequent chapters gets quite technical in its mathematical formulae and critique, but with sound examples firmly impressed in the reader's mind, not too much difficulty is encountered in following the explanations of the various control systems.

The point is constantly stressed that "the most important functions of a feedback control system are to attenuate the effect of disturbances and to follow reference input variations." Also, a stable system can be established if the disturbances attain constant values, thus enabling the controlled variables to attain constant values.

Because of the controversy in nomenclature on this subject, the authors quite wisely chose the terminology and symbolism as currently set forth by the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

The first six chapters were originally published informally in 1946 under the title "Automatic Regulation." Since then seven chapters have been added to enhance its usefulness.

Chapter seven discusses such design considerations as the characterization of the controlled system and the external influences that affect the performance of the closed loop. A section on simulitude is included.

Other chapters include the treatment of multiple-loop systems, the analysis of discontinuous control systems, servomechanisms and their operation in the analysis of pneumatic controllers, and the systematic and quantitative discussions of industrial control systems. In the chapter on "Pneumatically Operated Controllers," the feedback control systems widely used in industry are covered. The discussion centers about those components which are used in control of temperature, speed, pressure, flow, and liquid level.

A section of problems is included for anyone who is interested in seeing what type problems are encountered in feedback control systems. Also contained in this useful book is a bibliography, a glossary, and an appendix consisting of exponentials, trigonometric functions, decibel and octave charts.

The authors, William R. Ahrendt and John F. Taplin, drew upon their experiences in the field to widen the scope of the book. Mr. Ahrendt is president of the Ahrendt Instrument Co., and a lecturer at the University of Maryland. Mr. Taplin is a consultant engineer, and president of the Kendall Control Corp.

Equipment Drawings Add Value to Process Book

Chemical Engineering Operations, by E. Bamford. 5½ x 8½ in., xii + 376 pages, illustrated, indexed, stiff cloth binding. The Chemical Publishing Co., 26 Court St., Brooklyn 2, N. Y. $7.50

Containing over 200 excellent illustrations, this book offers to students and beginning chemical engineers the opportunity of familiarizing themselves with chemical process equipment and procedures. It discusses basic chemical processes describing them in their theoretical aspects with fundamental mathematical formulae. Illustrative examples are listed for every operation covered, with calculations of results and graphic presentation.

Books Received . . .

The Physical Chemistry of Surface Films, by W. D. Harkins. 6¼ x 9¼ in., xi + 413 pages, indexed, stiff cloth binding. Reinhold Publishing Corp., 330 West 42nd St., New York, N. Y. $10.00

Association Publications

Directory of American Council of Commercial Laboratories. A Guide to the Leading Independent Testing, Research, and Inspection Laboratories of America. 6½ x 10 in., 73 pages, leatherette cover. Directory is available to readers of industry and science upon request to: American Council of Commercial Laboratories, Inc., 4302 East-West Highway, Washington 14, D. C.

Selection of Oils for Carbureted Water Gas, Research Bulletin No. 9, by E. S. Pettyjohn and H. E. Linden. 8½ x 11 in., 52 pages, heavy paper cover, $4.00; and *Selection of Oils for High-BTU Oil Gas*, Research Bulletin No. 12, by H. E. Linden and E. S. Pettyjohn. 8½ x 11 in., 48 pages, heavy paper cover, $5.00. Institute of Gas Technology, Technology Center, Chicago 16, Ill.

Manual on Disposal of Refinery Wastes, Waste Gases and Particulate Matter, Volume II, Fourth Edition. 8½ x 11 in., 34 pages, paper cover. American Petroleum Institute, Division of Refining, 50 West 50th St., New York 20, N. Y. $1.50

The Consulting Chemist and Chemical Engineer in a World Economy. 8½ x 11 in., 29 pages, heavy paper cover. Association of Consulting Chemists and Chemical Engineers, Inc., 50 East 41st St., New York 17, N. Y. $1.00

Government Publications

National Annual Survey of Aviation Gasoline and Aviation Jet Fuel, October 1951 Production, Bureau of Mines Report of Investigations 4869, by O. C. Boole. 8½ x 10½ in., 17 pages, paper cover.

Pilot-Plant Batch Retorting of Colorado Oil Shale, Bureau of Mines Report of Investigations 4874, by W. E. Wells and J. H. Burtis. 8½ x 10½ in., 19 pages, paper cover.

Flammability of Amyl Nitrate, Bureau of Mines Report of Investigations 4877, by M. G. Zabetakis and G. W. Jones. 8½ x 10½ in., 5 pages, paper cover. All can be ordered, free of charge, from the U. S. Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

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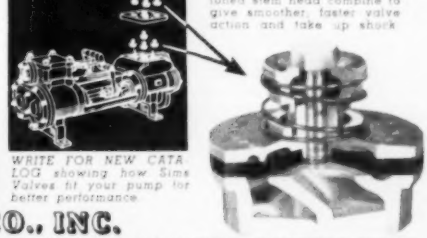

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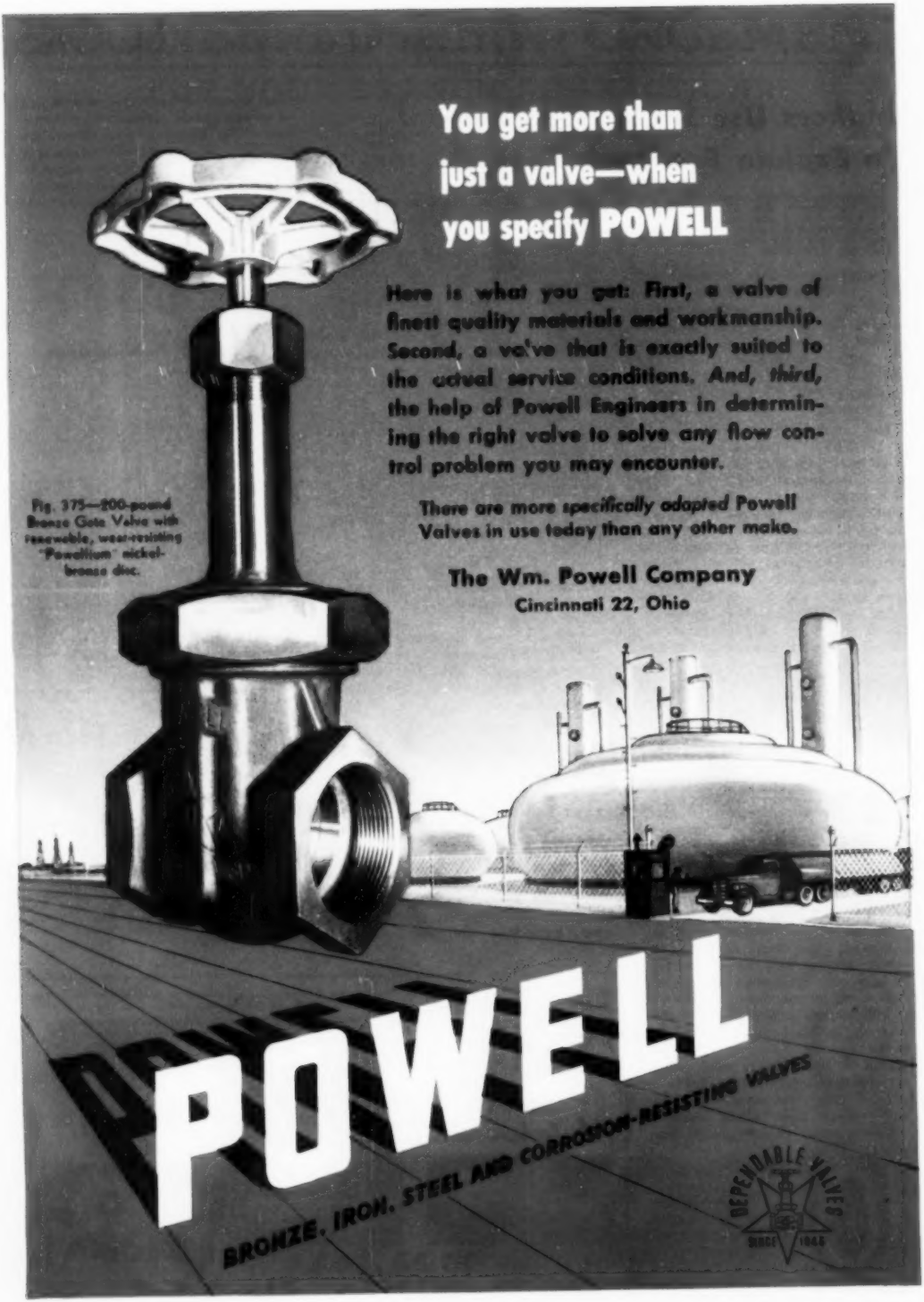
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High Rate of Refinery Output Rapidly Making Up for Loss in Strike Weeks

THE volume of crude oil charged to stills in June and July has already largely made up for the loss of about a third of refiners production during the May strike. Indicated crude runs in July were over 6,900,000 b/d avg., the highest on record. For the third week in July the API reported runs of 7,108,000 b/d avg., 97% of the operable refining capacity of the country.

Production of heating oils (kerosine and distillates), reversing the normal seasonal trend, has been high enough to bring U. S. stocks on July 26 to within about 3,000,000 bbls. of the total of July 28, 1951 (revised basis). Stocks buildup of heating oils since the industry resumed full-scale operations after the strike has been at the rate of around 4,700,000 bbls. a week. At this rate of accumulation, refiners difficulty will not be in providing the normal volume against next winter's needs, but rather in finding the available storage for this and other products.

The indicated rate of gasoline production is higher than the indicated rate of demand, continuing the trend of earlier months. This is reflected in stocks withdrawals, which for the U. S. were around 3,600,000 bbls. total for the period May 31-July 26, as against withdrawals of over 9,000,000 bbls. for June 2-July 28, 1951. Total U. S. stocks on July 26 were 118,287,000 bbls. as against 130,518,000 bbls. on July 28, 1951.

In 1951, U. S. heating oil stocks (kerosine and distillates) built up from 61,914,000 bbls. on March 31 to 111,026,000 bbls. on July 28, an increase of 49,112,000 bbls. or a weekly rate for the 17 weeks of 2,920,000 bbls. In a comparable 17-week period in 1952 (March 29-July 26) and including the strike shutdown, U. S. stocks increased from 64,716,000 bbls. to 107,821,000 bbls., an increase of 43,105,000 bbls., or at the rate of 2,536,000 bbls. weekly. However, in the eight weeks of this period since the strike, the buildup of heating oil stocks has been at the rate of 4,725,000 bbls. weekly. Continued accumulation of stocks at this rate would reach the U. S. total of 146,128,000 bbls. of Nov. 3, 1951 by the latter part of September.

For the country east of California, heating oil stocks on July 26 were 98,060,000 bbls., as compared with 101,156,000 bbls. on July 28, 1951; the rate of buildup of stocks in this area since the strike period has been 4,425,000 bbls. weekly. Total stocks east of California Nov. 3, 1951 were 136,300,000 bbls., made up of 35,500,000 bbls. of kerosine and 100,800,000 bbls. of distillate fuels.

Residual fuel is the only refined product where both volume of supply and demand is less than a year ago. For the first six months indicated refinery output was 3.2% less than in 1951, while demand was nearly 4% less.

New demand forecasts: Bureau of Mines now estimates total motor fuel demand for last six months of '52 at 4.8% over actual demand for last half of '51, earlier estimate was for 6.6% gain.

Total demand for heating oils (kerosine and distillates) is now placed at 7.3% over actual for last six months of '51, earlier forecast was for about 4% gain.

New estimate for residual demand is 3% higher than actual for last half of '51; earlier estimate was 2% larger.

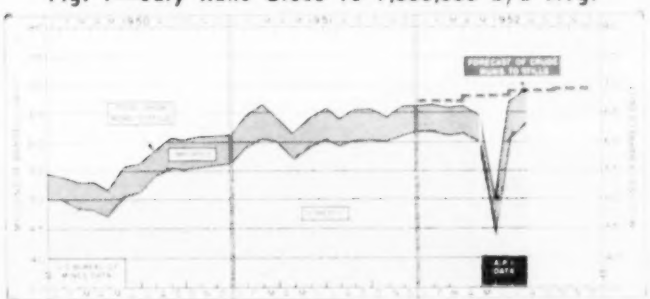
For Better Oil Products Statistics

Cooperation of refining and marketing companies is being sought by the API Department of Statistics, in an effort to improve current published data on supply and demand and inventories of refined products.

All oil companies giving operating and stocks figures monthly to the Bureau of Mines are being asked to be prompt in getting their figures to Washington by the 25th of the month, in order to speed up the release by the Bureau of its official Monthly Petroleum Statement and its report on Natural Gasoline and Allied Products.

In another step, arrangements have been worked out with the Bureau of the Census by Fred Van Covern, Director of the API statistical department, for Census to gather and publish monthly the totals on secondary inventories of gasoline, kerosine including No. 1 range oil, distillate fuels and residual fuels. The figures will be gathered from both the oil companies now reporting primary stocks and from local distributing companies. For companies reporting primary stocks, the difference between these figures as given to the Bureau of Mines monthly and their total inventories will be reported as secondary stocks. The Census Bureau is also planning to gather direct from the local distributing companies figures indicating their inventories at the end of the month. The figures of the two groups of companies will be combined and the totals for the four products published by PAD districts.

Fig. 1—July Runs Close to 7,000,000 b/d Avg.



Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Total (1000 bbls.)

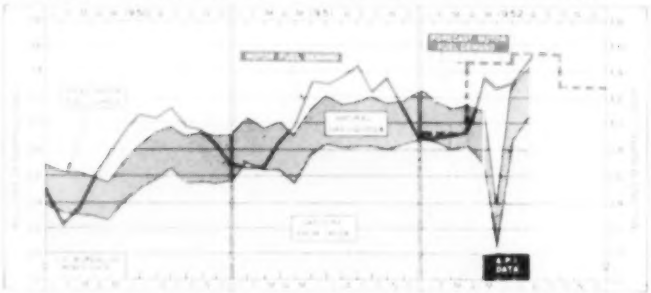
	Domestic	Foreign	TOTAL
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

BM Forecast of Crude Runs to Stills, 1952

Yields on Crude Runs to Stills

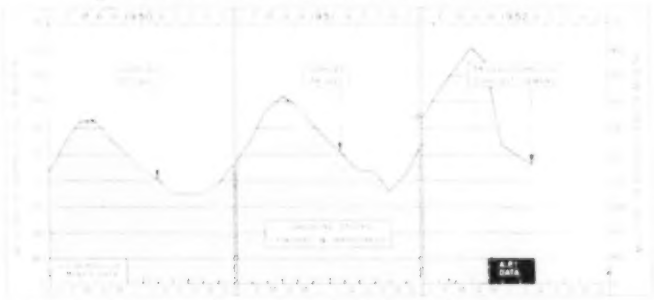
	Gasoline	Kerosine	Dist. Fuels	Resid. Fuels
	%	%	%	%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Fig. 2—July Motor Fuel Demand All Time High



* Natural Gas Liquids include gasoline blended at refineries, and that used as finished motor fuel

Fig. 3—Draft on Gasoline Stocks Slackens



*New basis for reporting added approximately 9,000,000 bbls. to primary stocks.

Fig. 4—Heating Oil Output Climbs in Hot Months

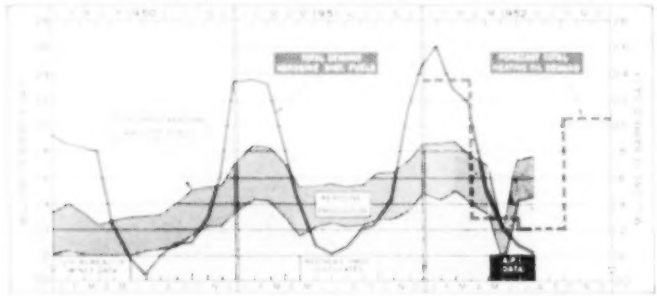
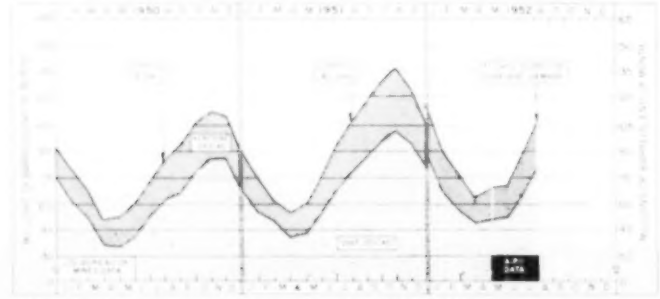


Fig. 5—Heating Oil Stocks in Rapid Buildup



*New basis for reporting added approximately 4,500,000 bbls. to primary stocks.

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
July '52 API*			
July '51 BM			
Change			
% Change			

* Through July 26

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mos. '52*			
6 Mos. '51			
Change			
% Change			

* Also estimated from API data

Motor Fuel Demand

Including Exports

Daily Average (1000 bbls.)

July '52 API*	
July '51 BM	
Change	
% Change	

* Through July 26

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mos. '52*	
6 Mos. '51	
Change	
% Change	

* Also estimated from API data

BM Forecast of Motor Fuel Demand, 1952

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

June '52 API*	
June '51 API	
May '52 BM	
July '51 BM**	

* Rev. July 26
** Revised basis

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
July '52 API*			
July '51 BM			
Change			
% Change			

* Through July 26

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mos. '52*			
6 Mos. '51			
Change			
% Change			

* Also estimated from API data

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
July '52 API*			
July '51 BM			
Change			
% Change			

* Through July 26

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mos. '52*			
6 Mos. '51			
Change			
% Change			

* Also estimated from API data

BM Forecast of Heating Oils Demand, 1952

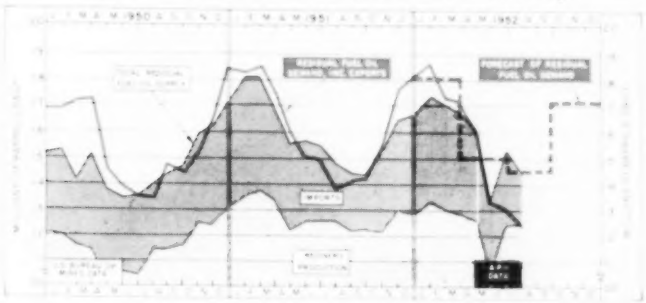
Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
June '52 API*			
June '51 API			
May '52 BM			
July '51 BM**			

* On July 26
** Revised basis

Fig. 6—Residual Fuel Imports Low in July



Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
1951 — 12 Mos.*			
1952 — 12 Mos.			
Change			
% Change			

* Through June 28

Total (1000 bbls.)

(Bureau of Mines Data)

1951 — 12 Mos.*			
1952 — 12 Mos.			
Change			
% Change			

* Data estimated from API data

Residual Fuels Demand

Daily Average (1000 bbls.)

1951 — 12 Mos.*	
1952 — 12 Mos.	
Change	
% Change	

* Through June 28

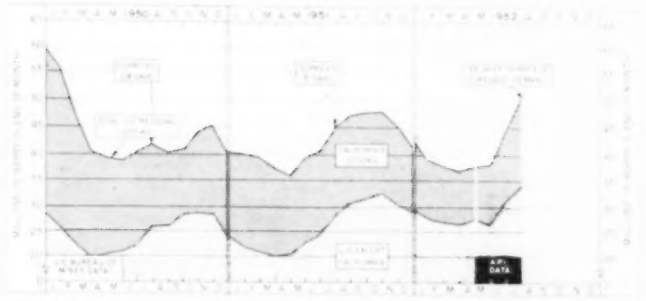
Total Demand (1000 bbls.)

1951 — 12 Mos.	
1952 — 12 Mos.	
Change	
% Change	

Average estimated from API data

BM Forecast Residual Fuels Demand, 1952

Fig. 7—Residual Stocks Highest since Early '50



*New basis for reporting added approximately 1,500,000 bbls. to primary stocks

Residual Fuel Stocks

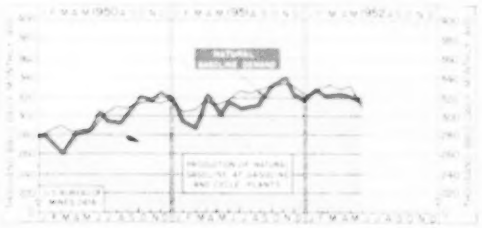
(000 bbls. end of month)

	U.S. Except California	Total U.S.
1951 — 12 Mos.*		
1952 — 12 Mos.		
Mar. — 31 BM		
May — 31 BM**		

* Also June 30

** Revised basis

Fig. 8—Production and Demand of Natural Gas Liquids



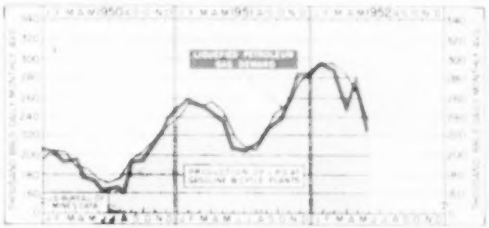
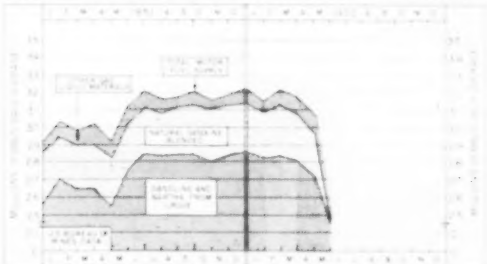


Fig. 9—Makeup of U. S. Motor Fuel Supply



(Figures in table in 1000 bbls./day average)

Month	Gasoline & Naphtha from Crude	Natural Blended	Other Gas Liquid Materials	Total Motor Fuel Supply
May — 31				
1951 — 12				
March — 31				
May — 31				

Natural Gas Liquids Statistics

(U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

	Production* (1000 gal./day avg.) Natural Gasoline	LPG	TOTAL	Demand** (1000 gal./day avg.) Natural Gasoline	LPG	TOTAL
Mar. — 31						
May — 31						
Change						
% Change						

	Total Production (1000 gal.)	Total Demand (1000 gal.)
1951 — 12 Mos.		
1952 — 12 Mos.		
Change		
% Change		

Stocks, End of Month (1000 bbls.)

Month	By Type of Product—At gasoline plants and terminals only: LPG	Natural Gasoline	Cond. Blended	Finished Gasoline	By Location: Gasoline Plants	Refineries	Total
Mar. — 31							
May — 31							
March — 31							

* Production includes receipts from refineries as well as natural production from natural gasoline and cycling plants. Receipts from refineries in May included production from 18 plants of natural gasoline and 2000 bbls. of naphtha.

** Demand data are for barrels reported; some produced for fuel and chemical purposes (about 1,500,000 bbls. in May).

† Includes naphtha and other products.

ADVERTISERS' INDEX

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(A8) AMERICAN LOCOMOTIVE CO. 1048
(A9) ANACONDA COPPER MINING CO. 1100
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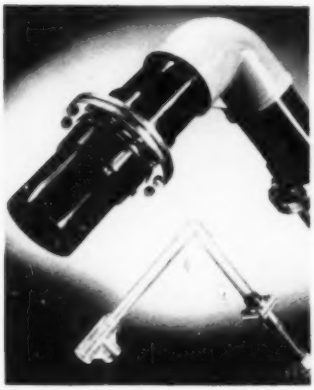

Molded Pipe Fittings Made of Corrosion-resistant Plastic

"Milex" pipe fittings, molded of tough "Tenite" plastic, are now available in ½-in. to 4-in. sizes and in a variety of clear transparent or black tees, elbows, laterals, and other couplings. They can be permanently joined to Tenite pipe quickly by means of a cement and solvent. Specially developed flange unions and flange adapter unions are available for joining Tenite to Tenite, and Tenite to steel. Colors other than black are available on special order. Tenite is shatterproof and remains unaffected by a wide range of weather and moisture conditions. Tenco Inc., 450 Endicott, St. Paul, Minn.

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Refinery Limitamp Reduced 60% in Size, 23% in Cost

A new refinery-type limitamp (Class I, Group D, Division 2) has been developed for a price approximately 23% lower than older designs. The use of a new manually-operated, oil-immersed, explosion-proof disconnecting switch in the primary circuit of the control transformer has eliminated an additional cubicle previously required for control power. This also permits a 60% reduction in the size of the unit. Other essential construction features include: 1) a complete squirrel-cage motor starter for either full- or reduced-voltage starting in a single cabinet, 2) isolation of high-voltage and low-voltage circuits by suitable barriers, 3) current-limiting fuses for the high-voltage power circuit, and for high-voltage and low-voltage sides of the control transformer, and 4) disconnect switch in the primary circuit of the control transformer mechanically interlocked with the door to prevent access to the high-voltage fuse compartment when fuses are carrying current. The redesigned unit measures approximately 34 x 90 x 40-in. General Electric Co., Schenectady 5, N. Y.

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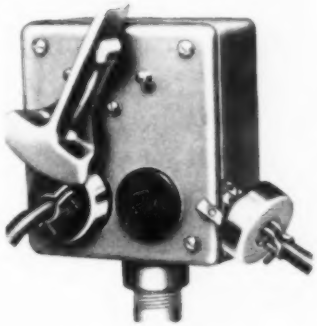
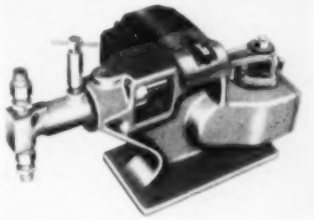


Sealed Mercury Switch Feature Of Safe Interlocking Socket

An interlocking receptacle which allows safe use of cord sets in hazardous locations, incorporates a sealed mercury switch which de-energizes each socket before a plug may be inserted or removed. The switch works on a cam lever which locks cord set caps in position after they are inserted. In the locked position the switch completes the circuit. An upward flip of the cam lever tilts the switch and results in a broken circuit. Cord caps can then be pulled out safely. The device incorporates standard, single or duplex receptacles to fit any conventional cord set. Ratings of either 115 V., 20 amp. or 250 V., 10 amp. are available. Interlock receptacles may be furnished for the following: single 3-wire; duplex 3-wire; dual 3-wire; single 4-wire; or dual 4-wire service. Tigerman Engrg. Co., 1332 North Western Ave., Chicago, Ill.

Circle No. 3 on Reply Card



Small Chemical Feed Pump Has Variable Capacity Range

Model X-52, "Adjust-O-Feeder," has been designed to provide accurate feeding of chemical solutions where low capacity and medium pressure meet requirements. This compact chemical metering pump has built-in, oil-enclosed gear reduction and a built-in standard motor eliminating any separate baseplate, gear box or couplings. The crank and connecting rod operate in a horizontal plane making the scale for the "Micro-Stroke Adjustment" convenient to read. A one piece iron frame gives positive alignment of all moving parts together with readily interchangeable measuring cylinders, stainless steel plungers, double ball check valves and trim, which provide for long life and inexpensive maintenance. The standard model weighs less than 100 lbs. and has an adjustable capacity range from 1 to 10 gph. discharging against pressures to 650 psig. Also available is a model with the same discharge pressure and capacity range 0.5 to 5 gph. G. Proportioneers Inc., 345 Harris Ave., Providence 1, R. I.

Circle No. 4 on Reply Card

Service Offered To Solve Complex Process Problems

Computer Corp. of America has inaugurated a service which is aimed at furnishing solutions to complex problems in dynamics for industrial organizations, government bureaus and researchers. The service provides for qualitative and quantitative studies in aerodynamics, servo-analysis, mechanical engineering, chemical processing, thermodynamics and other fields. Studies are directed to determine optimum specifications for a single component or a total dynamic system. Inquiries should be addressed to the company at 119 Church St., New York 7, N. Y.

Circle No. 5 on Reply Card

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New." Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

FOUR SEPARATE ANALYSES can be run simultaneously with the "Electro-Analyzer"

Four Analyses at Same Time

Laboratories that make use of electroanalysis can now take advantage of the new "Electro-Analyzer," with which it is possible to run up to four separate (or duplicate) analyses at the same time. The instrument is available in two- and four-spindle models. In both models, each spindle or station is equipped with its own independent components permitting a complete flexibility of schedule. The Electro-Analyzer offers 10 volts at 10 amps. and A. C. ripple is held to less than 2%. Close temperature control has been provided with a 200-watt thermostated heater that can be quickly fastened to the same vertical support rod that holds the beaker support. A stirring motor is located at each sample station and its two chucks will accommodate either glass stirrers or platinum stirring electrodes. Motor speed (650 rpm.) was specially selected to achieve speediest results. A wide variety of accessories are available with the instrument to "custom-tailor" it to specific laboratory needs. An important accessory is the Mercury Cathode Cell Kit which does away with time-consuming pre-analysis separations. The Electro-Analyzer is compactly housed in a single sturdy case, finished in light gray hammertone. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Circle No. **6** *on Reply Card*

Snubber Controls Gas Flows, Acts as Pulsation Damper

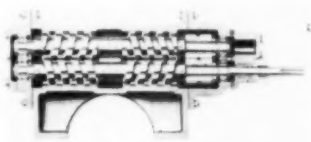
A new air flow snubber provides controlled slow rate of compressed air or gas flow for operating continuous-reading hydrostatic instruments, and also for purging pneumatic instrument lines. The unit also protects pneumatic testing and gaging equipment against damage that might result from surge pressure. It does this by providing a flow restriction in the line. The snubber is also used as a pulsation damper for pressure gages, recorders, manometers, and similar instruments. Placed in line between the instrument and the pressure source, the snubber "smooths over" pulsations so that the instrument gives a steady reading. If dirt or moisture plugs the unit at any time, the snubbing screw is removed and cleaned without disconnecting the unit from the line. The snubber is 1⅞-in. long by 1⅛-in. maximum over all, and is made of hexagonal brass rod throughout except for a neoprene O-ring used to seal the snubbing screw. Inlet and outlet ends are tapped for ¼-in. pipe. Flow rate is approximately 0.04 cu. ft./min. at a pressure drop of 70 psi.; maximum operating pressure is 1000 psi. King Engrg. Corp., Box 530, Ann Arbor, Mich.

Circle No. **7** *on Reply Card*

Tiny Indicators Designed For Valve Position or Liquid Level

Miniature indicators for liquid level and valve position, which occupy a minimum panelboard space, have been developed for a line of graphic panel instruments. The two units, similar in appearance, differ in the color of the indicating tapes and the availability of alarm switches on the level indicator. They can be utilized with any transmitting means giving a 3 to 15 psi. pneumatic signal. The overall size of either unit is 3½ x 6½ x 15½-in. The graphic panel cutout is 1⅝ x 5⅝-in. Scale length is 3⅛-in. for the valve position unit and 3¾ in. for the liquid level indicator. The smallest scale division is 25% and 2% of full scale, respectively. Reverse or direct action is obtained by means of a linkage attached to a standard 3-15 psi. pneumatic receiver, which provides sufficient force to eliminate tapping error. Transmitted pneumatic signals reach the pneumatic receiver by actuating the linkage that moves the indicating tape. Minneapolis-Honeywell Regulator Co., Industrial Div., Philadelphia, Penna.

Circle No. **8** *on Reply Card*



New Screw Pump Handles Both Viscous Fluids and Light Oils

Positive displacement of lubricating fluids or semi-fluids is possible with a new internal gear and bearing-type screw pump. Capacities range from 1 to 700 gpm. and discharge pressures are 1000 psi. for viscous liquids, and 500 psi. for light oils. The pump features 1) heavy duty roller bearings just inboard of the timing gears where radial load is heaviest, 2) lock nuts behind the timing gears for faster, simpler repairing, and 3) double-row angular contact ball bearings at the rear end which position the rotors axially for less wear on the bearings and timing gears. Other advantages include interchangeable rotor screws for inexpensive overhauling; no metallic contact beween the rotors for long rotor life and continued high volumetric efficiency thus reducing wear caused by erosion, only suction pressure on stuffing boxes for reduced leakage, longer packing life and easier servicing; direct-connection up to 1800 rpm. for use with high speed motors. Sier-Bath Gear and Pump Co., Inc., 9252 Hudson Blvd., N. Bergen, N. J.

Circle No. **9** *on Reply Card*

Noise Is Virtually Eliminated With Redesigned Blast Burner

Formerly, work on glassware with a blast burner meant plenty of noise by air blast. Not any more. New burners have been redesigned with one-piece gas and oxygen entering chambers. Leaks are greatly minimized. Any one of four basic working flames can be had by simple valve adjustments to produce small or large sealing or annealing flames. There are two models, the "Standard Blast" and the "Master Blast." In the standard model there are dual gas control valves for the dual (inner and outer) burners and a single oxygen control valve. The master blast has two completely independent burners built concentrically into the same burner body. The wide temperature range of this burner permits the working of tubing of ¼-in. to 3-in. in diameter. Both models are 7-in. in overall height. They are available in a "Type A" (for gases having 300 to 1500 Btu/cu. ft., such as natural, manufactured and mixed gases); and a "Type B" (for gases having 1500 to 2500 Btu/cu. ft., which includes some natural and most LP gases.) Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Circle No. **10** *on Reply Card*

Chrome Carbide Sample Kit Handy for Test Applications

A sample test kit containing a variety of shapes and sizes of the new "Grade 608" cemented chrome carbide is now available. The kit has been assembled to enable users to make a wide variety of metallurgical, physical and chemical tests to check corrosion, abrasion and erosion resistance of the carbide. Grade 608 is a strong and stable non-magnetic metal that contains 83% chromium carbide, 2% tungsten carbide and 15% nickel. It has about the same density as SAE steel and approximately the same thermal coefficient of expansion as steel. Fabrication and finishing techniques for these metals are identical to those for tungsten carbide. As far as the petroleum industry is concerned, the manufacturer states that because of its completely non-magnetic properties it is possible to make instrument components that are non-magnetic and yet highly resistant to wear and corrosion. Because chrome carbide has about the same thermal expansion rate as steel it is finding wide application in the gage manufacturing field where wear resistance of gaging surfaces and temperature effects of expansion are important considerations. The corrosion resistance of the chrome carbide gaging surfaces is also a factor in prolonging gage surface life. Included in the kit are: 1) three ¼-in. square bars, 2-in. long, 2) two ¼-in. square bars, 1-in. long, 3) three ½-in. OD, ⅛-in. ID, 4) one ⅛-in. dia. rod, 1-in. long. Price of the complete kit, including a technical bulletin, is $10.75. Carboloy Dept. of General Electric Co., Detroit 32, Mich.

Circle No. **11** *on Reply Card*

DID YOU MISS THESE?

The following items reviewed originally in the June issue, have aroused considerable interest. They are repeated briefly as a service to those who might have missed them the first time. For details or literature, use the regular Reply Card in this issue.

Regulator Maintains Control Of Constant Temperature Baths

The "Electron-o-Therm" is designed for precise temperature control of constant temperature baths used for refractometers, viscometers, ASTM equipment, and related apparatus. The regulator has no moving parts, preventing the contact sticking, oxidation, and wear. The resistance thermometer is hermetically sealed in Pyrex. Heater load circuit is actuated through an enclosed mercury-to-mercury plunger type relay. Transformer has very low flux leakage. Heater and electronic circuits are fused. Combined with the thermometer regulator is a precision bridge circuit, vacuum tube amplified controller. Operating characteristics are: range 30 to 225° C.; regulation limits, 0.001° C.; heater capacity, 1700 watts. Technical Equipment Co., 4348 San Pablo Ave., Emeryville 8, Calif.

Circle No. **12** *on Reply Card*

"Mirror" Makes an Effective Metallic Insulation Material

Savings in installation, operating and maintenance costs as well as cleaner appearance and low heat transfer are claimed for a new insulating material called "Mirror Insulation." It is made up of layers of thin metal sheets (an aluminum alloy) separated and held together by refractory "spacers." One eastern refinery recently ordered some 500 specially designed valve-covering units of this insulation as replacement for conventional insulation. The maker will "tailor-make" to suit any special application requirement. Standard pipe covering sizes range from ¼ to 30 in. O.D., with thicknesses from 1 to 2½ in., and in 30-ft. lengths. Hunter Mfg. Co., Bristol, Penna.

Circle No. **13** *on Reply Card*

Centrifugal Pump Filmstrips

How and Why of Centrifugal Pumps, Pump Maintenance, and Covering All Angles; three 35 mm. sound filmstrips, running time about 30 minutes each, covering the subjects indicated in great detail, including starting procedures, lubrication and packing maintenance, mechanical seals, piping hints, record keeping, pump selection, etc. Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Circle No. **14** *on Reply Card*

Piping Standards and Practices

How to Use Schedule Numbers in Power Piping Design, Bulletin 515A; eight-page reprint of an article explaining the relationship of the schedule number system to code formulas for determining the wall thickness of power piping; including two selection charts. Taylor Forge & Pipe Works, P.O. Box 485, Chicago 90, Ill.

Circle No. **15** *on Reply Card*

SULFUR and CARBON *Analyses* in PETROLEUM PRODUCTS

The sulfur content of oils, waxes and greases is an important measure of the value and quality of the product.

Whether the desired sulfur content be high or low, it is necessary to know exactly what amount is present.

The combustion method offers a rapid and sure means of determining sulfur in the wide range of percentages and materials encountered in the oil and grease field.

The Dietert-Detroit Sulfur Determinator embodies the correct principles of the combustion method in a simple, rugged and convenient form. Complete analysis can be made in less than five minutes.

Carbon determinations on organic compounds are being made in as little as two minutes with the Dietert-Detroit No. 900-S Carbon Determinator.

This method can be applied to any petroleum product. One example of the usefulness of this method is the analysis of cracking catalyst for carbon content.

Leading oil companies* are taking advantage of these versatile, time-saving determinators. Write to Dept. P-5 for detailed information on how you can apply rapid carbon and sulfur analysis to your problems.

*Two typical users — THE SHELL OIL COMPANY / THE PURE OIL COMPANY

CONTROL EQUIPMENT
HARRY W DIETERT COMPANY
9330 ROSELAWN • DETROIT 4, MICH.

Polyethylene Plastic Cover Protects Instrument Lines

Known as "Dekoron Impervapak Metl-Cor," this corrosion-proof instrument tubing harness is composed of a bundle of copper or aluminum tubes over which is extruded a $\frac{1}{16}$-in. thick sheath of high molecular weight black polyethylene plastic. The manufacturer states that Impervapak Metl-Cor has lower initial cost than corrosion-resistant alloy tubing, costs less to install than individual instrument lines and conserves critical materials. Although easily bent for installation, it is sufficiently rigid to eliminate many of the intermediate supporting brackets which are necessary with individual tubes. A standard line of pressure-tight fittings is used to join successive lengths. Standard core is supplied with 4, 7, or 10 metal tubes of $\frac{1}{4}$ or $\frac{3}{8}$-in. outside diameter, and is available in lengths up to 50 ft. Other sizes can be supplied on special order. Samuel Moore & Co., Dekoron Tubing Div., Mantua, Ohio.

Circle No. **16** *on Reply Card*

Lubricated Valves Serviced By Portable Pressure Pump

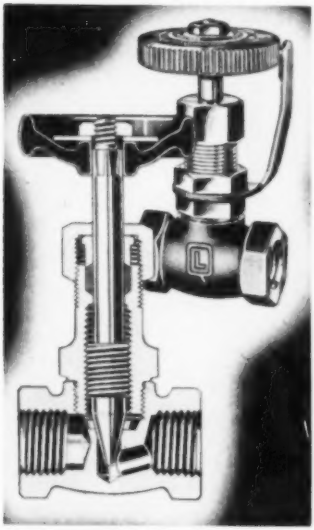
Greater speed and efficiency in the servicing of lubricated valves is claimed for a new high-pressure, portable, hand-operated lubricant pump. The pump develops up to 10,000 psi, and is designed to handle light and heavy lubricants in all kinds of weather. Any lubricated valves equipped with high pressure, hydraulic or button head fittings may be serviced from the 10-ft. hose assembly, which is swivel-coupled to prevent kinking. The entire top of the pump lifts off to simplify filling or for changing containers. The unit is 25 in. high, 14 in. wide, and the container, holding 30 gals. of lubricant, is 9 in. in diameter. Lincoln Engrg. Co., 5703-14 Natural Bridge Ave., St. Louis 20, Mo.

Circle No. **17** *on Reply Card*

Flow Colorimeter Simplifies Analyses of Unit Operations

A flow colorimeter has been developed to simplify continuous analysis and control of flowing or static streams in liquid or gaseous processes. Its uses include continuous color control for the indication of color and turbidity in municipal and industrial waters, controlling the bleaching of petroleum oils, monitoring poisonous gases, and many other operations. Meter readings can be quickly converted directly into concentration of gas or liquid in a sample, and by using a potentiometer-type recorder, a continuous record can be maintained of a flowing or static sample of gas or liquid. By connecting a standard recorder-controller, continuous control of the process can be maintained. The colorimeter has a total spectral range from 350 to 1000 millimicroms and the instrument is so designed that any desired spectral region within this range can be conveniently obtained by the use of interchangeable filters, thus assuring maximum flexibility and simplicity. When handling highly corrosive gases or liquids, full protection for the instrument is provided by a design feature which permits intermittent or continuous purging of the case with an inert gas through readily accessible inlet and outlet ports provided for this purpose. Also, water cooling coils placed around the tungsten lamp and two walls of the cell compartment maintain equilibrium temperature of the instrument within two degrees of room temperature. It operates on standard A. C. circuits. Beckman Instruments, Inc., South Pasadena, Calif.

Circle No. **18** *on Reply Card*



Regular and Indicator Models Offered in Gland-Type Valves

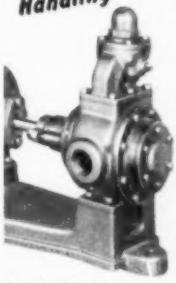
Manufactured in a full range of sizes from ¼-in. to 1-in. in both globe and angle patterns, the "Gland-Type Bronze Needle Valve" is ideal for use in pin-point control on small lines where fine regulation of flow is essential. The handwheel design lends itself to delicate finger-tip control. The globe is available in ¼-in., ⅜-in., and ½-in. sizes. The angle comes in ¼-in. and ⅜-in. sizes. The new control valve is also being produced in an indicator model, the handwheel being made of cast bronze with numbered graduations indicated on its face permitting resetting to a predetermined degree of opening. A spring clip engaging serrations on the outside of the wheel, holds the valve securely at its proper setting. The Lunkenheimer Co., Cincinnati 14, Ohio.

Circle No. **19** *on Reply Card*

Mechanical Devices Positioned By Hydraulic Control System

"Hydrotorque," a hydraulic positioning single tube control system independent of outside energy, hydraulically positions valves, throttles, engine speeds, winches and brakes, diesel engines, metering nozzles and a wide variety of other mechanical devices. The system can be used in locations previously considered impracticable, such as corrosive, high heat, and dirty locations. Calibration of dials is to custom requirements and can be made to read in inches of water, psi., gpm., up-down or any given designation. In bronze, cast iron, cast steel, needle or 3-way, the units can be utilized when com-

BLACKMER
Self-Adjusting for Wear
ROTARY PUMPS
for Liquid Materials Handling



THE LIFETIME PUMP WITH REPLACEABLE VANES AND LINERS TO CUT COSTS

10 TO 1500 GPM

Get FACTS About Petro-chemical Rotary Pumps . . .

See why Blackmer Pumps are preferred for liquids from ether to asphalt.

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GRAND RAPIDS, MICH.

QUALITY Glidden PRODUCTS

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℞ *Use the PROVED Soybean Additive*

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● Here is the finest soybean additive that can be used to improve the performance of lube oil, fuel oil, grease or gasoline. From the first shipment, Gliddol has been made under rigid laboratory control to prescription standards.

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SOYA PRODUCTS DIVISION
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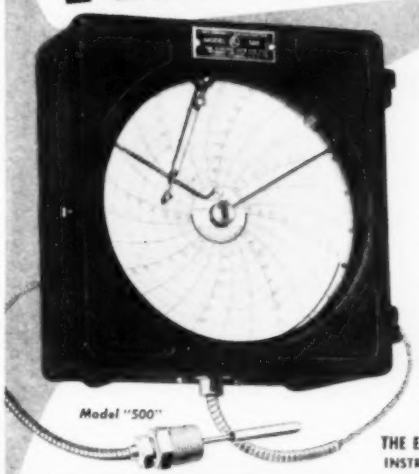
AUTO-LITE



Model "500"

Temperature Recorder with capillary tubing for EYE-LEVEL reading. Priced from $42.50

. . . for TEMPERATURE RECORDING

★ This low-cost protection gives permanent proof of temperature behavior.

★ Various standard chart ranges from minus 40°F. to plus 550°F.

★ 3 standard types; choice of 24-hr. or 7-day cycle

Send for new catalog G-143-B, describing many styles of Auto-Lite temperature indicators and recorders.

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS & INDICATORS

(*To obtain more data on advertised products see page* 1192)

WEATHERCOAT is specified by leading refinery designs engineers.*

WEATHERCOAT is the standard for maintenance in leading refineries.*

Make these tests:

- Troweling Ease—Cold
- Flexibility with Toughness
- Freedom from Shrinkage
- Mixes with Sand for Scratch Coat (or buy ready-mixed MASTIC WEATHERCOAT)

Send for information. Prove to yourself that WEATHERCOAT gives the best yield and is the easiest to apply.

*Names on request.

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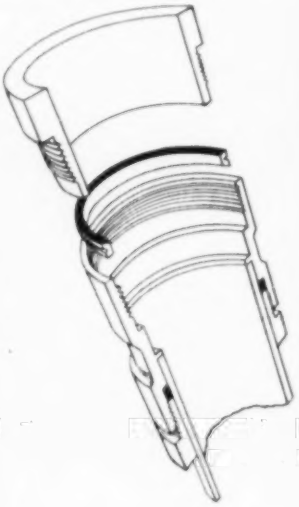
200 BUSH ST., SAN FRANCISCO 4, CALIF.

Providence 14, R. I. · Perth Amboy, N. J.
Baltimore 3, Md. · Columbus 15, Ohio · Mobile, Ala.
Tucson, Ariz. · Seattle, Wash. · St. Louis 17, Mo.
Baton Rouge 2, La. · Inglewood, Calif.
Oakland 1, Calif. · Portland 7, Ore.
Washington 6, D. C. · San Juan 23, P. R.

What's New!

plete freedom from fire hazard, the high cost of air systems, or the insecurity of auxiliary power and low cost installation are requisites. Farris Hydrotorque Corp., Engrg. Dept., 529 Commercial Ave., Palisades Park, New Jersey.

Circle No. 20 on Reply Card



Plastic Pipe Has 3600 psi Effective Tensile Strength

The development and production of improved rigid plastic pipe and a new compression type coupling which incorporates a radically different design has been announced. Characteristic of this new pipe and fitting include increased resistance to burst, high tensile and flexural strengths, greater chemical resistance, and the ability to withstand sunlight. They feature resistance to rot and rust, and an ultimate tensile strength of approximately 6,000 psi, and an effective tensile for piping applications of 3,600 psi at room temperature. Flexural modulus is 250,000 psi and impact is 4.3 Izod (notched). Burst pressure varies according to pipe diameter (1-in. diameter has burst pressure of over 1000 psi) and is sufficiently great for installations involving moderately high pressures. It is supplied in 10 and 20-ft. random lengths from ¼ to 2-in., which can be connected quickly by means of the new compression type coupling or by slip-sleeve tees and ells. Threaded adapters can be furnished to facilitate connection of this new plastic pipe with previously installed metallic piping systems. Carlon Products Corp., 10225 Meech Ave., Cleveland 5, Ohio.

Circle No. 21 on Reply Card

"International"
SIDE ENTERING
MIXERS AND AGITATORS
FOR GASOLINE
AND LUBRICATING OILS
"INTERNATIONAL" HEAVY DUTY, SIDE ENTERING MIXERS are designed for horizontal mounting below the liquid level in a tank. Particularly adapted to the blending of gasoline and other liquids in large batches.
REPACKED FROM OUTSIDE WITHOUT TANK LEAKAGE—These Mixers are of latest design. Equipped with a Ball Thrust Bearing to eliminate end-thrust on gears and motor. Send for Bulletin P-72 showing all Types of Mixers, Gearmotor and V-Belt Drive, in sizes from ½ to 30 H.P.
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CHICAGO— 407 S. Dearborn St. WAbash 2-0733

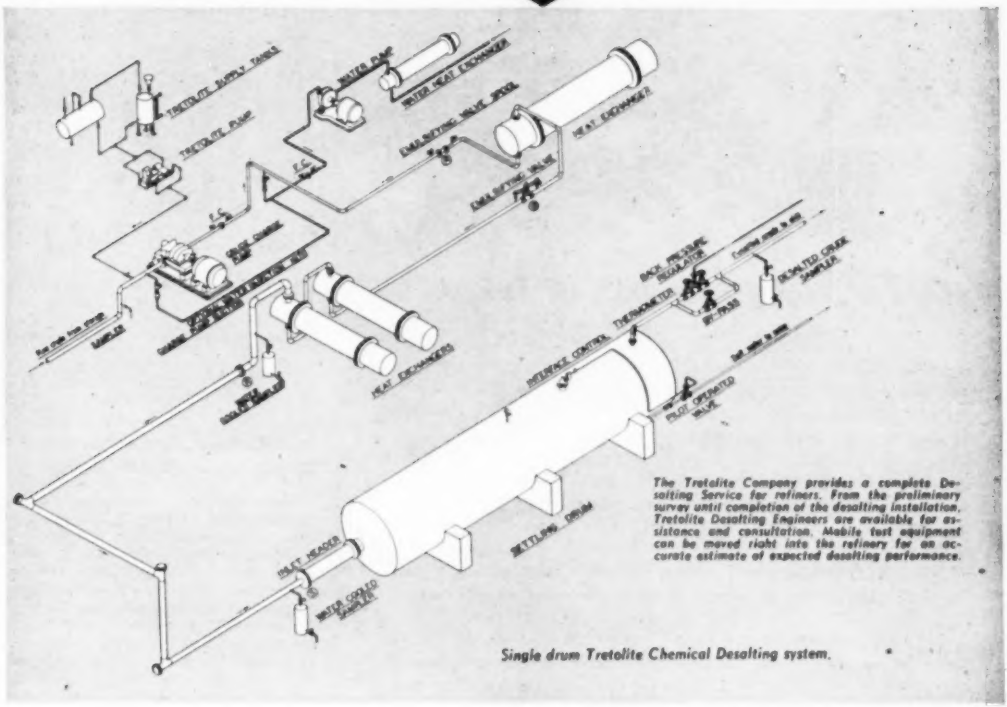
NEW CONSTANT
DIFFERENTIAL RELAY
TYPE 6000
For purge systems, liquid level and specific gravity measurements.
Maintains constant purge rate regardless of down stream pressure changes
• Supplied with fixed flow rate orifice • Eliminates supply pressure regulator • Pressure rating 600 P.S.I. • Supplied with differential indicator • Standard flow rates available .5-1-2-5-25-50 S. C. F. H.
Write for Illustrated Bulletin.
INSTRUMENTS, INC.
122 N. Madison Tulsa 6, Okla.

(*To obtain more data on advertised products see page* 1192)

TRETOLITE DESALTING

UTILIZES CONVENTIONAL REFINERY EQUIPMENT

Examine the flow diagram below, note the equipment required. Every item is conventional, already available in most refineries. A Tretolite Desalting plant often can be assembled from existing refinery equipment, thereby holding installation costs at minimum.



The Tretolite Company provides a complete Desalting Service for refiners. From the preliminary survey until completion of the desalting installation, Tretolite Desalting Engineers are available for assistance and consultation. Mobile test equipment can be moved right into the refinery for an accurate estimate of expected desalting performance.

Single drum Tretolite Chemical Desalting system.

A recent survey of Tretolite Desalting installations disclosed that Tretolite is now desalting over 1,000,000 barrels per day, with an average salt-removal percentage of 95, at an average cost per barrel of 2.5 mills.

For complete information on Tretolite Desalting, write or call the

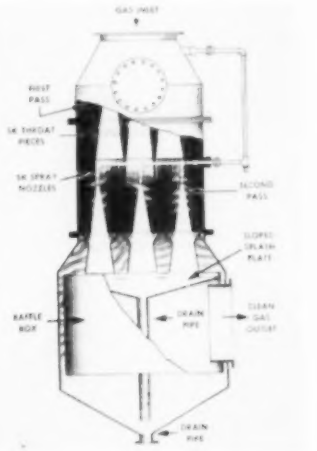
TRETOLITE COMPANY

ST. LOUIS 19, MISSOURI • LOS ANGELES 22, CALIF.

TD 52-3

Packaged Gas Scrubber Has Two "Passes" for Efficiency

The SK "Packaged" Gas Scrubber will handle gas containing wettable solids and condensable gases as well as gases and solids which can be cleaned by obtaining a chemical reaction between the gas or solids and selected spray liquid. In the case of gases containing non-wettable solids or dust—carbon black or metal oxides for example—a suitable wetting agent can be introduced into the spray liquid. Advantages, claimed by the manufacturer, include: 1) it is so designed that foam surge will not choke the unit, 2) provides maximum contact between the spray liquid and the gas, 3) contains an integral separating unit for separating the spray liquid after scrubbing, 4) it can be arranged for vertical down-flow or for horizontal operation, 5) operates with a minimum loss of pressure, 6) attains high scrubbing efficiency, and 7) little maintenance is required. In operation, the gas enters the scrubber through an inlet pipe. Suction action of the spray from the nozzles draws



the gas into the throat pieces of the first bank in the scrubber, where the liquid and gas are thoroughly mixed. Mixed gas and liquid is discharged into another bank of spray nozzles and throat pieces. As the gas enters each bank it is entrained and forced through the throat pieces and when leaving the last bank it is washed, cooled and discharged through an outlet pipe. Schuette and Koerting Co., Dept. J-I, Cornwells Heights, Bucks County, Pa.

Circle No. 22 on Reply Card

Process Time Cycles Varied By Electrical Plug-In Units

"Add-A-Cycle Timer" has been developed for testing of components and other operations in which it is desirable to have available a wide range of time cycles. Set-up time is reduced to a minimum through plug-in adjustable timers, supplied in six overlapping ranges from 1.5-12 seconds to 15-120 minutes. Thus it is possible to have adjacent cycles with widely varying time limits. Add-A-Cycle is furnished as a basic unit having two plug-in positions, and any number of them may be cabled together and will cycle as a group so that an unlimited number of time cycles may be obtained. Normal rating is 10 amps, 115 V., 60 cycles, but special ratings may be had upon request. For process timing the unit is custom built in wall mounting cases, allowing great flexibility and providing easy servicing. An additional feature is that any cycle may be skipped without loss of time in the event any part of the process is temporarily out of use. Becker Equipment Co., 3020 No. Cicero Ave., Chicago 41, Ill.

Circle No. 23 on Reply Card

Corrosion—AN ALLY OF THE ENEMY

CORROSION—the great saboteur—works night and day making old storage tanks useless and necessitating costly repairs to new. In some sour crude areas, new tanks have been rendered useless in as little as 18 months.

Now, with steel again in short supply, you will have to get the maximum years of life from each tank so there may be more steel for defense.

NATASCO products will prevent corrosion from getting a start on your new tanks and prevent further corrosion on old ones.

NATASCO corrosion prevention products have been proved by years of successful use. NATASCO also provides experienced crews for the preparation and application of these products.

CONTRACT SERVICES:
Tank Welding Repairs and Maintenance
Installation of Tank Appurtenances
Tank Painting
Application of Protective Coatings
Tank Cleaning—BS&W Emulsion Chemical Treating

Learn how you can get the most in years of additional service from your tankage. Wire, telephone or write for complete information.

The Natasco Company
P. O. BOX 1316 TULSA, OKLAHOMA

Lease Tank Service—West Texas Area: Williams Construction Co., Odessa, Texas
California Representative: Coast Contractors, Inc., 2627 Atlantic Ave., Long Beach 6, Calif.
New England Representative: The McKin Company, P. O. Box 711, Portland, Maine

ORBIT VALVES®

for Safer Storage and Handling Specify. . . . ORBIT

On L.P.Gas Units

BRANCHES

HOUSTON, TEXAS
407 Velasco
Serving the Gulf Coast

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402 West County Road
Serving West Texas

CASPER, WYOMING
LeRoy Mitchell Distributing
Serving the Rocky Mountain
States and Canada

Orbit Forged Steel L. P. Gas Valves offer three way protection against vapor leaks.

1. **Positive Friction Free Seating**
2. **Welded Bonnet Construction**
3. **Permanent Adjustable Stem Packing**

PLUS Additional protection of an all forged steel body and bonnet. Forgings are of a known strength and density, being more homogeneous than castings, thus further eliminating the possibility of vapor leaks.

Afford yourself of the *additional protection* ORBITS have to offer when used where LP-Gas is manufactured, handled, stored and loaded

—Sold by Supply Stores—

ORBIT VALVE CO.

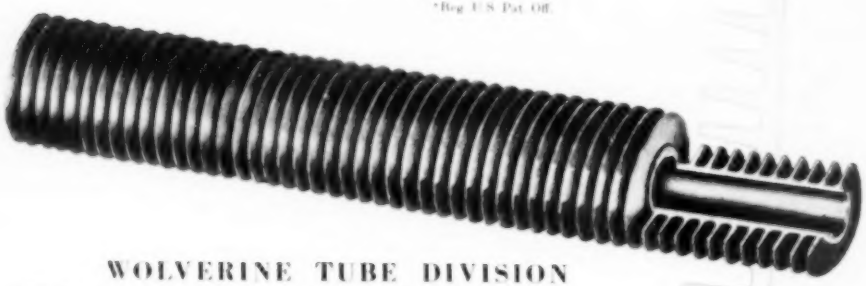
P. O. BOX 699 TULSA, OKLAHOMA

all one piece ...finned tube

The fins are extruded from the tube itself

These two views show the construction of Wolverine Trufin* — the integral finned tube. The large drawing illustrates how the fins are formed from the wall of the tube and remain a part of it. Thus, Trufin's efficiency is unaffected by vibration or sudden temperature changes. This finned tube can be fabricated as easily as plain tube. Trufin has an outside surface area many times that of plain tube and points the way to greatly increased efficiency. In addition Trufin can often help you reduce unit size, installation and maintenance time, thus lowering your costs. Find out about Trufin, the integral finned tube, and its relation to your own heat transfer application. Available in a variety of sizes, fin spacings and alloys. Send for your copy of the new brochure, Wolverine Fabricated Parts.

*Reg. U.S. Pat. Off.



WOLVERINE TUBE DIVISION

Calumet and Hecla Consolidated Copper Company

Incorporated

Manufacturers of tubing exclusively

1123 CENTRAL AVENUE • DETROIT 9, MICHIGAN

Plants in Detroit, Michigan and Decatur, Alabama; Sales Offices in Principal Cities

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

Export Department, 13 E. 40th St., New York City 16, N. Y.

Trade Literature

Protective Coatings

Stop Your Losses From Corrosion; 12-page booklet gives specifications and applications data on "Micro-Seal" asphaltic coating compounds of a special chemical dispersion type used as corrosion-proofing products; a 15-page supplement is enclosed which contrasts chemical dispersions of asphaltic compounds with water emulsions and cutback asphalts, also covering material and application specifications for various coating types. Anderson Prichard Oil Corp., Oklahoma City, Okla.

Circle No. **24** *on Reply Card*

Film On Nickel Plating Pipe

"The Alco Products Story," a new industrial movie by the American Locomotive Co., among other features shows the new manufacturing techniques developed for the production of nickel-plated pipe by Alco for the Atomic Energy Commission; shows how products are developed and manufactured for the oil, chemical and power industries. Prints of the film are available to interested groups on request. Alco Products Div., Dunkirk, N. Y.

Circle No. **25** *on Reply Card*

Engineering Economics

Battelle Research In Engineering Economics; 16-page booklet discusses economics of engineering in relation to management planning, industrial market research, raw materials studies, research planning, research operations, and industrial logistics and location; includes case histories. Battelle Memorial Institute, Columbus, Ohio.

Circle No. **26** *on Reply Card*

Research Instrumentation

Instruments Accelerate Research, Data Book 15-14; 96-page re-issue of Bulletin 15-14 brings data and design of various analytical equipment up to date; catalogs latest instruments and equipment in the laboratory, analytical and measurement fields. Minneapolis Honeywell Regulator Co., Brown Instruments Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

Circle No. **27** *on Reply Card*

Acid-Proof Materials

Eonite Pipe and Fittings, Bulletin 139; *Eonite Lacquer,* Bulletin 190; and *Acid Proof Construction,* Bulletin 160; first of these bulletins (six pages) describes furan resin fabricated pipe and fittings with advantages, sizes and connections available, includes engineering drawings; second bulletin (four pages) describes uses for a protective lacquer on process equipment with application and preparation methods; third bulletin (five pages) describes a thermoplastic material effective for surface protection of process vessels and towers, underground concrete tanks, steel or concrete shells, concrete basins and floor areas. Aqua-Therm Inc., 39-79 Torrance St., Dayton, Ohio.

Circle No. **28** *on Reply Card*

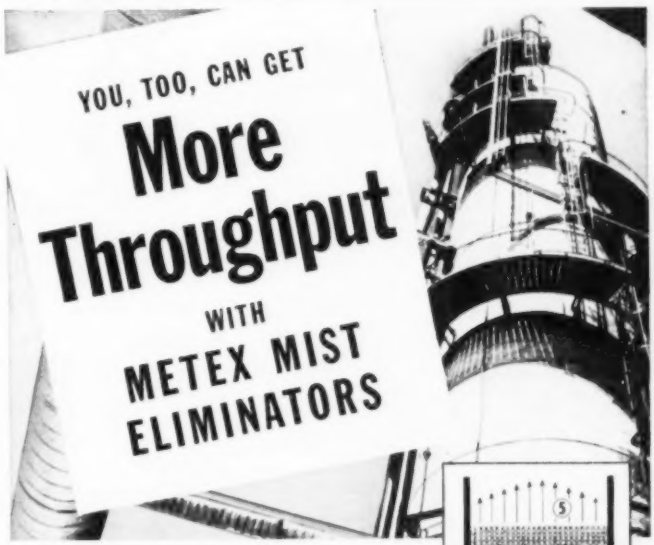
Instrument Movie

Information at Work is a 30-minute full-color film which traces the development of instruments from those which do a relatively simple job to today's indicating, recording and control instrumentation techniques employed in the most complex processes; the film may be booked without charge through the public relations department of Taylor Instrument Co., 95 Ames St., Rochester 1, N. Y.

Circle No. **29** *on Reply Card*

Compact Control System

Bailey Mini-Line Equipment, Bulletin BG040-2; 16-page booklet describes improvements in controls for power plants and industrial processes of a pneumatic control system with

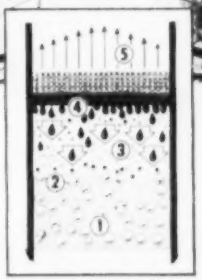


From the recovery of liquids entrained in discharge gases to the removal of contaminators to further processing, these simple knitted-wire pads are daily contributing to greater on-grade throughput, increased efficiency and lowered costs in refineries from coast to coast.

Metex Mist Eliminators do just one thing — remove liquids entrained in gases. The diagram shows how they are doing it in stills, towers, cats, knock-outs, evaporators and other vessels.

Efficiencies 95% and better • Little if any pressure drop • Easily installed in existing equipment • Made of practically any metal • No valves or moving parts to service.

Worth looking into, isn't it? For full information, write for free copy of "Metex Mist Eliminators," an 8-page brochure that's packed with facts.



HOW IT WORKS

(1) Gas passes through liquid. (2) Bursting gas bubbles produce fine spray of liquid droplets. (3) Droplets are entrained in rising stream. (4) Droplets coalesce on knitted-wire surfaces to form large drops that fall back against the flow. (5) Gas passes on, freed from entrainment. The liquid is returned.

METAL TEXTILE CORPORATION

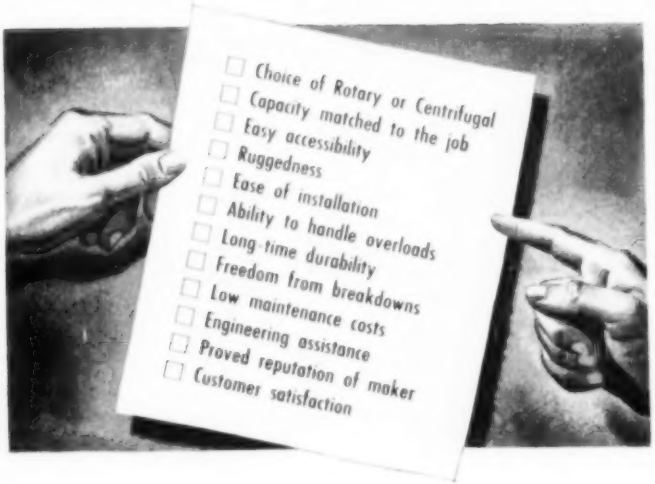
KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

METEX

631 East First Avenue, Roselle, N. J.

(To obtain more data on advertised products see page 1192)

BEFORE BUYING *any* BLOWER COMPARE THESE ESSENTIALS



When production depends so vitally on adequate handling of gas or air, you can't afford to take chances on the performance of your blowers or exhausters. It's better to be safe than sorry.

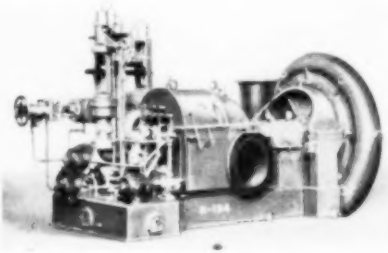
So, for new installations or replacements, we suggest that you evaluate the equipment by the above standards of comparison. This will help determine the unit that will be most effective, economical and reliable for your specific applications.

Be sure to include the R-C *dual-ability* line of both Centrifugal and Rotary Positive types. Remember, that only we offer you this *dual choice* —with unbiased recommendations from almost a century of experience. With capacities from 10 cfm to 100,000 cfm or higher at moderate pressures, R-C equipment has a long record of outstanding performance in industrial applications.

We'll gladly send detailed information for comparison—or supply engineering help if we can be of service.

ROOTS-CONNERSVILLE BLOWER CORPORATION
521 Texas Avenue, Connersville, Indiana

CENTRIFUGAL



Type OIB Gas Exhauster. Capacity 19,000 cfm, driven by 332-hp steam turbine.

ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC.

What's New!

details on functions of the small size pneumatic transmitter, indicators and recorders, control relay, selector valve, positioning relays, power units and control room design. Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio.

Circle No. **30** *on Reply Card*

Electronic Flow Meter

Potter-Brown Electronic Flow Meter, Instrumentation Data Sheet No. 103-5; four-page folder describes a flowmeter measurement of fluids over an extremely wide range of temperatures and pressures with an accuracy of ½%; discusses the three component parts of the flowmeter, and also the circular chart recorder, multi-point recorder, precision indicator, and maintenance operation. Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Wayne and Windrim Aves., Philadelphia 44, Pa.

Circle No. **31** *on Reply Card*

Braided Packings

Garlock Lattice-Braid, Bulletin AD-131; eight pages containing sectional drawings showing the structure of braided packing materials, illustrations of the various tpes, tables showing general service recommendations, specifications, and reports from users. The Garlock Packing Co., Palmyra, N. Y.

Circle No. **32** *on Reply Card*

Corrosion-Proof Equipment

Permanite Equipment, Bulletin No. 6; four-page folder describing the properties and uses of "Permanite," stoneware, used in the fabrication of such corrosion proof chemical equipment as absorption towers, reaction tanks, scrubbers, agitators, dampers and valves. Maurice A. Knight Co., Akron 9, Ohio.

Circle No. **33** *on Reply Card*

Pipe Fittings

Beaird Cast Steel Fittings; four-page cardboard folder describes five advantages of cast steel flanged and screwed fittings with illustrations and descriptions of return bends, special fittings and fittings stock; details are given on flanged fittings. J. B. Beaird Co. Inc., Shreveport, La.

Circle No. **34** *on Reply Card*

Removal of Tramp Iron

Non-Electric Permanent Magnetic Separators for Tramp Iron Removal, Catalog 15-A; 16-page booklet illustrates various magnets used in industry to solve problems caused by metal contamination; includes specifications of bantam, extrapower, ultrapower, superpower, and giant model magnets, with descriptions on how-to-use magnets in line, pipe, and flow assemblies. Eriez Mfg. Co., Erie, Pa.

Circle No. **35** *on Reply Card*

What's New!

Aluminum Tube Fittings

Aluminum Triple-Lok Fittings, Bulletin 4316B2, four pages covering current standard stock line of 12 aluminum tube fitting shapes with pictures showing the various uses fittings are put to, e. g., refinery and chemical plant; includes listing of distributors throughout the country. The Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

Circle No. **36** *on Reply Card*

Heat Exchangers

The G-R Twin G-Fin Section, Bulletin No. 1400; 20-page brochure gives design features, construction details, tables of dimensions, specifications, industrial process applications, and installation arrangements of finned tube heat exchanger units. The Graseoni-Russell Co., Dept. L, Massillon, Ohio.

Circle No. **37** *on Reply Card*

Eliminating Pulsation Vibration

Burgess-Manning Co. Pulsation Survey and Analysis; four-page description of how excessive pulsation vibration and noise in discharge piping from gas driven compressors was reduced by installation of snubbers, based on actual field analysis in a Southwest chemical plant. Burgess-Manning Co., 1203 Dragon St., Dallas, Tex.

Circle No. **38** *on Reply Card*

Water Soluble Resins

Lustrex X-700 Series Water Soluble Resins, Development Bulletin; nine pages describing a series of water soluble modified styrene polymer resins, supplied as finely divided, free flowing, off-white powders which dissolve readily in water to produce solutions stable over a wide pH range. Monsanto Chemical Co., Plastics Division, Springfield 2, Mass.

Circle No. **39** *on Reply Card*

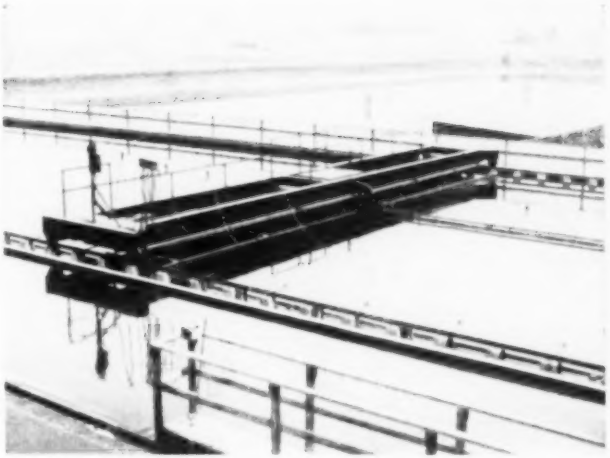
Turbine Vane Pumps

Peerless Turbine Vane Pumps, Bulletin No. B-2205; 12 pages containing drawings, selection charts and descriptions of standard and self-priming turbine vane pumps for pumping small capacities of hot or cold, clear and vaporous liquids against medium and high heads. Food machinery and Chemical Corp., Peerless Pump Div., Los Angeles 31, Calif.

Circle No. **40** *on Reply Card*

Gate Valves

W-K-M Process Plant Valves, Bulletin 698; four pages describe engineering and operational advantages of valves designed for refinery and petrochemical plant service which includes expanding gate operation with leverlock assembly; covers lubrication aspects of valves in service, the Venturi pattern valve and propane



Typical installation of Hardinge Rectangular Clarifiers in oil refinery installation for treatment of waste water. These clarifiers remove oil and sludge from the water.

HARDINGE SEPARATORS TREAT 30 MILLION GALLONS OF OIL REFINERY WASTE WATER DAILY

A recent installation of Hardinge Rectangular Clarifiers, for separating oil from the refinery waste water, handles 20,800 gallons per minute—nearly 30 million gallons a day. The skimmers remove 35 gallons per minute of oil from the water surface or more than 50,000 gallons per day.

This installation, occupying more than 2 acres, employs five Hardinge units. Thousands of dollars were saved on this installation because Hardinge equipment could be used with existing settling tanks.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA—240 Arch St. Main Office and Works

NEW YORK 17 • SAN FRANCISCO 11 • CHICAGO 6 • HIBBING, MINN. • TORONTO 1
122 E. 42nd St. 24 California St. 205 W. Wacker Dr. 2016 First Ave. 200 Bay St.

(To obtain more data on advertised products see page 1192)

valve. W-K-M Co., P. O. Box 2117, Houston 1, Tex.

Circle No. **41** *on Reply Card*

Thermocouples and Accessories

Thermocouples, Assemblies, Parts and Accessories, Catalog EN-S2 (replaces Catalog NS2); 45-page booklet contains illustrations and descriptions of available couples and couple assemblies for general applications. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Circle No. **42** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

Styrene Resins

Lustrex Latices, Bulletin No. 58, 12 pages on styrene resins covering chemical and physical properties, compounding to form waxes, thickening agents, pigments, clay and other fillers, and suggested applications; includes tables and graphic data. Monsanto Chemical Co., Plastics Div., Springfield, Mass.

Circle No. **43** *on Reply Card*

Use of Flexible Couplings

De Laval Crown Couplings, Bulletin 2200, four pages gives construction data on rubber bushed crown couplings which are used on various power driven machines; includes chart which indicates the coupling size to be used on machines of various horsepower ratings and speeds. De Laval Steam Turbine Co., Trenton 2, N. J.

Circle No. **44** *on Reply Card*

Improved Hand Tachometers

EZ Universal Hand Tachometer; two pages of data on two new tachometers with construction description, explanation of the damping mechanism, rotating gear shift and centrifugal governor principle, and outstanding advantages; includes specifications. O. Zernickow Co., 15 Park Row, New York 38, N. Y.

Circle No. **45** *on Reply Card*

Research Instrumentation

Optical and Electronic Building Blocks, Bulletin 103; 24-page brochure discusses unitized optical and electronic components capable of dealing with any research problem involving monochromatic light; monochromators illustrated with accessories. The Perkin-Elmer Corp., Norwalk, Conn.

Circle No. **46** *on Reply Card*

Flow Rate Control

Kates Direct Acting Flow Rate Regulators, Bulletin 521; four pages discussing principles involved in flow regulators, economy in maintenance and servicing, and installation features; includes an engineering drawing, and capacity chart for four regulator sizes, and different applications. W. A. Kates Co., 430 Waukegan Rd., Deerfield, Ill.

Circle No. **47** *on Reply Card*

Literature Offered

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature offered in this issue's advertisements:

ACTIVATED ALUMINA. Information offered by Aluminum Co. of America. See adv't p. 1175.

ADDITIVES. Information on Santolube 266 offered by Monsanto Chemical Co. See adv't p. 1061.

AIR PREHEATERS. Bulletin offered by American Locomotive Co. See adv't p. 1040.

ANALYZERS, end-point. Bulletin 36 offered by Baird Associates, Inc. See adv't p. 1164.

ANALYZERS, sulfur and carbon. Detailed information offered by Harry W. Dietert Co. See adv't p. 1156.

BLENDERS, automatic. Descriptive literature offered by "Proportioneers," Inc. See adv't inside front cover.

CATALYSTS, cracking, dust type. Descriptive information offered by The Davison Chemical Corp. See adv't pps. 1090-1091.

CHEMICALS, toluene derivatives. Information offered by Hooker Electrochemical Co. See adv't p. 1070.

CONTROL, temperature. Catalog 101 offered by Foxboro, Inc. See adv't p. 1109.

COOLING WATER TREATMENT, chlorination equipment. Information offered by Wallace & Tiernan Co., Inc. See adv't p. 1170.

COOLING WATER TREATMENT. The Langelier Method. Technical paper No. 123 offered by W. H. & L. D. Betz. See adv't p. 1056.

CONTROLLER, pneumatic. Bulletin C-1 offered by Conoflow Corp. See adv't p. 1202.

CONTROLLERS. Details offered by The Foxboro Co. See adv't p. 1087.

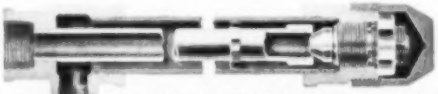
DESALTING. Information offered by The Trefolite Co. See adv't p. 1160.

DRUMS, reconditioning. Booklet F7629 offered by Oakite Products, Inc. See adv't p. 1185.

This Plant Claims Their

HEAT SAVINGS PAID for NICHOLSON TRAPS

Nicholson expansion steam traps were installed by a processor on tank heaters and coils where various unit temperatures from 160 to 185 F had to be maintained. The steam temperature was 320 F. Figuring the difference in heat loss between Nicholson traps discharging condensate at 160 and others discharging it at about steam temperature, they feel heat loss was cut nearly in half. Due to their effectiveness in controlling temperature as well as draining condensate, Nicholson traps are paying for themselves in many industries.



For All Equipment Using Steam or Hot Water

CATALOG 751 OR SEE SWEET'S

Absorption Stills, Agitators, Evaporators, Gas Holders, Heat Exchangers, Heavy Oil Tanks, Kettles, Petrolatum Tanks, Pipe Coils, Radiators, Reboilers, Steam Stills, Tar Tanks, Wax Tanks

215 Oregon St., Wilkes-Barre, Pa.

W.H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

What's New!

FIRE FIGHTING EQUIPMENT: air foam: Data offered by Foster Manufacturing Co. See adv't p. 1174.

FITTINGS, pipe: Catalog 1000 offered by The Parker Appliance Co. See adv't p. 1102-1103.

FITTINGS, welded: Catalog 50 offered by Bonney Forge & Tool Works. See adv't p. 1166.

GAGES, pressure: Bulletin offered by Instruments, Inc. See adv't p. 1159.

GAGES, liquid: Bulletin CF-1250 offered by The Yarnall Recovery Systems Co. See adv't p. 1071.

GASOLINE STORAGE STABILITY: Paper entitled "Stability of Present-Day Gasolines" offered by E. I. DuPont de Nemours & Co., Inc. See adv't facing pps. 1112-1113.

GENERATOR, oxygen-nitrogen: Information offered by Air Products, Inc. See adv't p. 1180.

HEAT EXCHANGERS: tubular: 32-page bulletin offered by Griscom-Russell Co. See adv't p. 1117.

HEAT EXCHANGERS, sectional baffle: Bulletin 101 offered by The Brown Fintube Co. See adv't p. 1062.

HEATERS, oil: free flowing: Bulletin 10-F offered by Schutte and Koerting Co. See adv't p. 1159.

HEAT TRANSFER, medium: "The Dowtherm Story" offered by Dow Chemical Co. See adv't p. 1098.

INSULATION, PRODUCTS: Technical bulletin offered by The Philip Carey Mfg. Co. See adv't p. 1175.

METERS, flow: Variable Area Handbook offered by Fischer & Porter Co. See adv't p. 1195.

MIST ELIMINATORS: 8-page brochure offered by Metal Textile Corp. See adv't p. 1169.

MIXERS AND AGITATORS: side entering: Bulletin P-72 offered by International Engineering, Inc. See adv't p. 1198.

MIXING EQUIPMENT: "Turbinizer": Bulletin T-52 offered by The U. S. Stoneware Co. See adv't p. 1178.

MOTOR SELECTION AND APPLICATION COURSE: Bulletin GEA-4938-B offered by General Electric Co. See adv't pp. 1102-1103.

PACKINGS: lattice-braid: Folder offered by The Garlock Packing Co. See adv't p. 1111.

PAINT: Data offered by Sherwin-Williams Co. See adv't p. 1176.

PAINT, corrosion preventive: Information offered by The Nafasco Co. See adv't p. 1206.

PAINT, mastic: Information offered by American Bitumuls & Asphalt Co. See adv't p. 1198.

PAINT, rust preventive: Complete literature offered by Rust-Oleum Corp. See adv't p. 1181.

PIPE CUTTING, guided torch: Literature and sample offered by Vernon Tool Co., Ltd. See adv't p. 1207.

PUMPS, rotary: Facts offered by Blackmer Pump Co. See adv't p. 1197.

REACTOR, cascade: Information, yield and inspection data offered by The M. W. Kellogg Co. See adv't pps. 1118-1119.

REFRACTORY LININGS, for catalytic equipment: Book entitled "Cone Source" offered by Bigelow-Liptak Corp. See adv't p. 1069.

SAFETY, for small refineries: Serial A-2948 offered by E. I. DuPont de Nemours & Co., Inc. See adv't facing pps. 1112-1113.

STEAM TRAPS, expansion: Catalog 734 offered by W. H. Nicholson & Co. See adv't p. 1206.

TANKS, cleaning: Serial A-1131 offered by E. I. DuPont de Nemours & Co., Inc. See adv't facing pps. 1112-1113.

THERMOMETERS: Catalog G-141-B offered by The Electric Autolite Co. See adv't p. 1197.

TURBINES, general purpose: Information offered by Westinghouse Electric Corp. See adv't p. 1071.

VALVES: Specification Bulletin offered by Rockwell Mfg. Co. See adv't pps. 1084-1085.

VALVES, control: Bulletin 700-2 offered by Minneapolis-Honeywell Regulator Co. See adv't p. 1171.

VALVES, control: Rider-ring type valve capacity computer offered by Kieley & Mueller, Inc. See adv't p. 1166.

VALVES, control: General catalog 1200B offered by The Atkins Co. See adv't p. 1086.

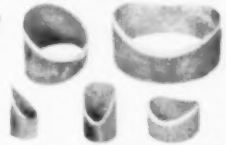
VALVES, gate: Catalog 4250 offered by Wedgeplug Valve Co., Inc. See adv't p. 1120.

VALVES, plug: Catalog offered by Sims Pump Valve Co., Inc. See adv't p. 1187.

MAKE BEVELED CUT-OFFS LIKE THIS

WITH THE

VERNON "PIPE CUTTING" PANTOGRAPH



This portable, semi-automatic guided torch machine produces saddle and insert type tee intersections, straight or beveled cut-offs, miters and lateral intersections for most pipe sizes from 2" to 24". No layout or templates required and all cuts are extremely accurate and require no cleaning or hand-fitting. No limit to length of pipe that can be handled. Proved in the field and backed by 20 years of experience and engineering development.

Write for literature and actual sample of cut pipe

VERNON TOOL CO., LTD.

1099 Meridian Ave. Alhambra, Calif. — 6226 Washington Ave. Houston 7, Texas

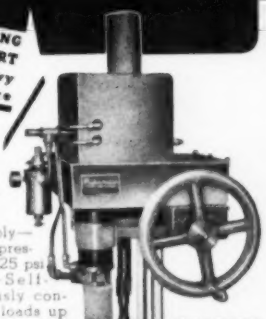
CENTRIFUGAL PUMPS • REAMERS
VIBRATING SCREENS
PIPE CUTTING PANTOGRAPHS
STEEL VALVES • STUFFING BOXES

NEW! GEAR-DRIVEN PNEUMATIC OPERATOR FOR THROTTLING CONTROL SERVICE

Rotomotor

PNEUMATIC POWER POSITIONING OPERATOR

ACCURATE POSITIONING TO WITHIN 1/500th PART of STEM TRAVEL on Heavy Duty Throttling Service



A wholly new and different valve operator employing a reversible pneumatic motor and a precision gear driven screw stem, with these AMAZING advantages:

Operates on 100 psi supply—Sensitivity to instrument pressure changes as small as .025 psi—Perfect stability—Self-locking stem—Continuously connected handwheel—Stem loads up to 40,000 lbs.—Stem travels up to 24" Stem speeds up to 36" p.m.—Compact design.

So different, you will want to investigate its possibilities immediately.

REQUEST BULLETIN C-1

Cono-Controls

CONOFLOW CORPORATION
2100 Arch St., Phila. 3, Pa.

EDITORIALS

Casualties of the Steel Strike

THE ending of the strike of the nation's steel workers by no means terminates the effect on the petroleum industry of shutting off steel manufacture for almost two months.

The oil companies use about 9% of the steel produced in the country, and shortages of drill pipe, casing and line pipe were making themselves felt in producing operations before the strike ended. The resultant shutting down of drilling wells, particularly wildcatting, may delay the discovery of new underground reserves necessary to our future supplies of petroleum. The strike lost to the oil companies their fourth quarter allocations of steel by the PAD, over 2,000,000 tons. The refinery engineering firms report that steel shortages will delay their new refinery and gasoline plant construction projects by at least two months, perhaps longer, despite their plans to use larger working forces on their projects when materials are available.

The drying up of consumption of oil products in steel plants, mainly around 1,000,000 bbls. weekly of fuel oils, is causing distress in some refineries through accumulations of heavy fuel oil in storage. Four oil companies in July were forced to curtail plant operations because of inability to handle or store the heavy fuel oil that must also be made if refineries are to run to make other needed products.

These effects of the steel strike on the oil industry are, of course, felt primarily by the members of business itself. It is indeed unfortunate that a more direct effect was not felt by the general public, which happens in the case of strikes in the railroad or telephone and similar industries that deal directly with the public.

More serious to all of us than any material shortages resulting from the steel strike, however, was the arrogant flouting of individuals' rights on the part of a CIO union leader to force the compulsory unionization of steel company workers. R. E. Wilson, board chairman, Standard Oil Co. (Indiana), termed this issue "the greatest threat to the individual liberty of the working man since slavery." V.B.G.

Sharpening Our Statistics

A MEANS for improving our regularly issued data on supply, demand and stocks on hand of petroleum refined products, has been prepared by the API Department of Statistics.

For one thing, it is calling on the oil companies who report monthly on production and stocks at their refineries and natural gas plants to the Bureau of Mines to see to it that their reports are in Washington by the 25th of the month. General observance of this date would in turn make it possible for the Bureau to issue its Monthly Petroleum Statement and its Natural Gasoline and Allied Products report by around the 5th of the month following. The data would then reach the oil companies within 5 to 6 weeks after the month reported on. The negligence of about 40% of companies reporting in sending in their figures is now delaying the compiling and issuing of the reports by three weeks or more. For example, the Bureau's Monthly Petroleum Statement on May operations was released in Washington on July 29th. This statement covered the period when the strike of refinery workers shut down about a third of the country's refining capacity. Thus refiners and other interested parties did not know, for more than 8 weeks after the ending of the strike, how greatly the industry's production and inventories were actually affected.

In normal operating periods, it is true, the API Department of Statistics' weekly report on refinery activity accurately reflects the trend of plant operations and inventories, and it is published within 5 days after the week covered. The API data is based on plant operating department figures, while the Bureau's statement in most instances is based on reports from the companies' accounting departments. There are naturally some differences, mainly in inventory figures.

The Bureau's report also is much more detailed and covers imports and exports as well as domestic supply and demand. It shows the extent of use of natural gas liquids in our motor fuel supply. It gives data on lubricating oils and other products not covered in the API statement. It represents the industry's official data on refinery operations. It is always of historic interest but its value as a guide to current operations depends on how promptly it can be placed in the oil companies' hands. This is an opportune time for the companies to examine their reporting methods and the Bureau of Mines its procedure, to expedite the release of these important reports to the industry.

As a second step in improving statistics helpful to refiners and distributing companies as well, the API Statistical Department is making arrangements with the Bureau of the Census to gather and publish monthly data on secondary stocks of gasoline, kerosine, distillate fuels and residual fuel oils. These are stocks in local distributing channels, but not including consumers' supplies, as distinguished from primary stocks at refineries and in large terminals where material is rehandled. The knowledge of the extent of these secondary stocks, by PAD districts, together with the data on primary stocks now reported by the Mines Bureau and the API, would benefit the industry in more accurately sizing up future consumptive demand by geographical areas.

The data on secondary stocks, as proposed by the API to the Bureau of the Census, would be gathered both from the large oil companies and the smaller companies with strictly local operations. The latter companies, most of them unfamiliar with the accepted trade association technique for presenting industry-wide statistics, have heretofore been hesitant in reporting their inventory totals through the API, as was earlier proposed. Under the sponsorship of an agency independent of the industry, however, they should cooperate in this new effort to compile data on secondary stocks. The figures of all reporting companies would be confidential to the Bureau of the Census and the totals, based on data from all companies, would be helpful to oil companies large and small. —V.B.G.

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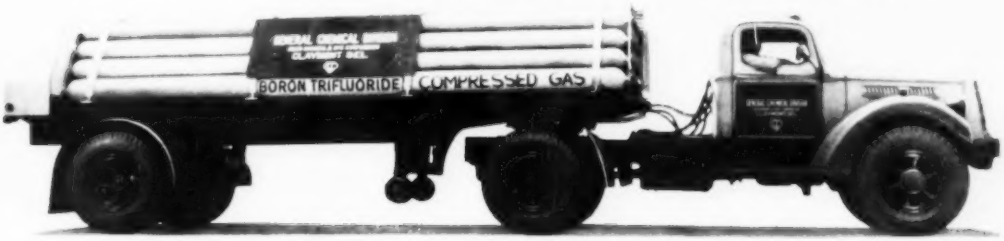

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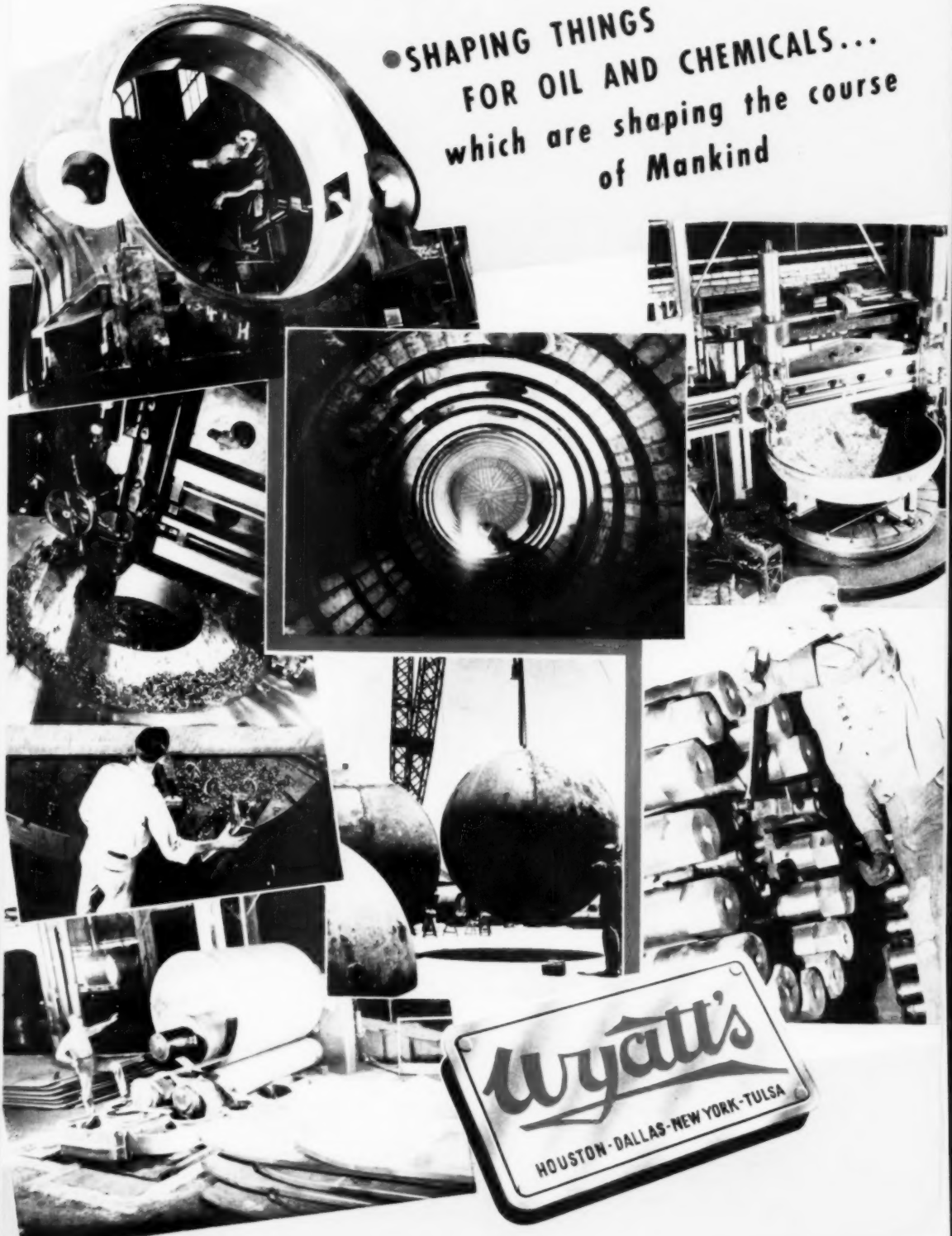
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